The Aviation Historian®

The modern journal of classic aeroplanes and the history of flying

Out of the Woods

How the Harrier escaped Healey's axe

ISSUE 29

Published quarterly by:
The Aviation Historian
PO Box 962
Horsham RH12 9PP
United Kingdom

Subscribe at:
www.theaviationhistorian.com

ISSUE NUMBER 29
(published October 15, 2019)

Published quarterly by *The Aviation Historian*, PO Box 962, Horsham RH12 9PP, United Kingdom

ISSN 2051-1930 (print)
ISSN 2051-7602 (digital)

Printed in the UK by
The Magazine Printing Company
using only paper from FSC/PEFC suppliers
www.magprint.co.uk

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Editor's Letter

A VERY WARM welcome to the final issue of 2019, a year fat with significant aviation anniversaries: we take an in-depth look at a few more of them in *TAH29*.

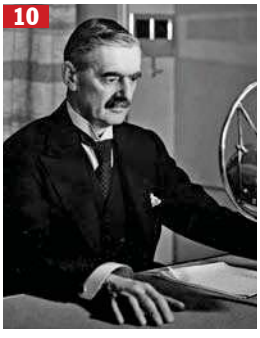
Starting on page 10 is Greg Baughen's unsentimental examination of the RAF's state of readiness when Neville Chamberlain delivered his mournful declaration that Britain was at war with Germany, in September 1939, 80 years ago. The British air arm had used the crucial time bought by Chamberlain at Munich to boost its capabilities — but were they the capabilities it would need for the onrushing conflict?

Among several important 50th anniversaries this year were the first flight of Concorde in March 1969, and the entry into RAF service of the extraordinary Hawker Siddeley Harrier the following month. In this issue, French aviation historian Jean-Christophe Carbonel celebrates the former with his excavation of a 1958 Sud Aviation brochure detailing technical plans for a nuclear-powered "Super-Caravelle" (the original name for France's early SST projects) with delta wings and canards, that, perhaps thankfully, remained just a designer's fantasy on the road to Concorde. The second of those 1969 anniversaries prompted Professor Keith Hayward to continue his autopsy of Britain's post-war aeronautical industry with a look at the political birth — and very nearly early death — of the Harrier's forerunners, the P.1127 and Kestrel. As he explains, the ultimate success of the Harrier was a "damn close-run thing". See pages 48–56.

There's much else here besides anniversaries, however; a particular highlight for me is Matt Bearman's masterful interweaving of the British and American stories of "laminar flow" research, which brings forward some fascinating — and surprising — insights. A special acknowledgment must go to the Farnborough Air Sciences Trust — the world-class organisation at Farnborough with a vast (and shamefully little-lauded) collection of unparalleled aeronautical research material, without which Matt's article could not have been written. Keep up the good work, chaps!

FRONT COVER ***A Hawker Siddeley Harrier GR.1 of No 233 Operational Conversion Unit is prepared for a sortie from a field base in Germany in the early 1970s. See page 48.*** TAH ARCHIVE

BACK COVER ***Chipmunk G-AMUC of Air Service Training frolics over Portsmouth Harbour. See*** **Garuda's Hamble Boys** ***on p40.*** TAH ARCHIVE



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Letters to the Editor

Asian adventure

SIR — Ray Flude's *Kommando Japan* article in *TAH26* mentioned the 1937 von Gablenz expedition from Iraq to China; a friend has just sent me a number of photographs taken during that venture.

The crew of Junkers Ju 52/3m D-ANOY *Rudolf von Thüna* consisted of pilots Carl August von Gablenz and Robert Untucht, with senior mechanic Karl Kirchhoff. The aircraft had been specially fitted with more powerful BMW 132L engines and carried additional fuel tanks in the cabin to bring the total amount of fuel to more than 5,000lit (1,100gal).

On their return flight one of the engines started to misfire and they had to make an emergency landing at the oasis of Chotan (Hotan) in China's Xinjiang province. Kirchhoff replaced the spark plugs and the crew were ready to continue their flight when gunshots peppered the windscreen of the Ju 52/3m, followed by arrest and incarceration in the citadel of Chotan. As D-ANOY failed to arrive in Kabul and there was no communication from the crew, Lufthansa sent out three other Ju 52/3ms to look for it: D-AEHE, D-AOLO, and D-AXAT. The first two were not regular Lufthansa aircraft, but two former Luftwaffe machines that had had their armament removed and three extra 525lit (115gal) fuel tanks fitted in the cabin.

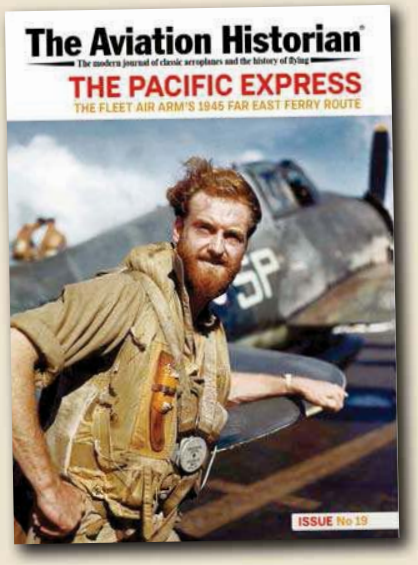
D-ANOY and its crew were released after four weeks of imprisonment; they arrived in Kabul on September 27, and soon took off for the return flight to Germany; but the aircraft's port engine was still causing problems and, after landing in Tehran, they decided to leave D-ANOY and continue in D-AEHE instead. They finally received a rapturous welcome on arrival back in Berlin in that aircraft on October 3.

Lennart Andersson *Uppsala, Sweden*

DEHLAX 3

TAH ***author Lennart Andersson (see his letter on this page) has sent us these photographs as a postscript to the third of Ray Flude's articles on the Axis powers' plans for strategic air-transport routes, published in*** **TAH26. ABOVE LEFT** ***An impressive view from Junkers Ju-52/3m D-ANOY as it flies through the Himalayas.*** **TOP RIGHT** ***The aircraft's captain, Carl August von Gablenz and*** **LOWER RIGHT** ***the aircraft's chief mechanic Karl Kirchhoff.***

A CASE OF MISTAKEN IDENTITY FAA flyers



The pilot in the striking World War Two colour photograph at* LEFT, *which adorned the cover of* TAH19, *was inadvertently misidentified in our caption inside that issue. He is actually Sub-Lt Charles Lavender, not Sub-Lt John "Jack" Haberfield, who is seen in the black-and-white image at* RIGHT. *Both airmen were members of the Fleet Air Arm's 5th Naval Fighter Wing, and in investigating the error we found that both of them had interesting careers that were sadly cut short — as related below.

MURD

PUBLICATION OF Tim Hillier-Graves's book *Heaven High, Ocean Deep* (Casemate, ISBN 978-1-61200-755-7) earlier this year — about the exploits of the 5th Naval Fighter Wing (NFW) in the carrier *HMS Indomitable* during World War Two — set some some alarm bells ringing; or, rather, Klaxons blaring. Readers quickly spotted that a striking colour photograph of a ginger-haired airman in the book's colour section, which had also appeared on the front cover of *TAH19* a couple of years ago, was identified by Hillier-Graves as one Charles Lavender, not as Jack Haberfield as we had done.

Subsequent correspondence between us and the book's author and publisher, plus *TAH* subscriber — and Editor of *Pilot* magazine — Philip Whiteman, confirmed that we had indeed got the identification wrong, as had also happened in a number of other places where the image has appeared.

Charles Lavender

Sub-Lieutenant Charles James Lavender, the subject of the colour photograph, was from Enfield, Middlesex. He was an original member of No 1844 Sqn, one of the two units making up the 5th NFW (the other being No 1839 Sqn, to which Haberfield belonged). Lavender remained with the squadron, surviving the war and eventually returning home safely on *HMS Illustrious*. In May 1952 he was awarded the Distinguished Service Cross for operations in Korea. Three-and-a-half years later, as a chief flying instructor and still only in his mid-30s, he died on November 10, 1955, when he was piloting Supermarine Attacker FB.2 WP281, while avoiding a collision with a Percival Sea Prince over RNAS Stretton in Cheshire.

Jack Haberfield

Sub-Lieutenant John Kerle Tipaho "Jack" Haberfield, sadly, suffered a more drawn-out fate. A New Zealander of Maori descent, he gained his pilot's licence in 1938 and in 1940 applied to join the Fleet Air Arm. After training in the UK and Canada he was posted to 1839 Sqn, which was working-up before joining the *Indomitable*. Having been Mentioned in Despatches for gallantry in action in October 1944, he was shot down on January 24, 1945, while taking part on the first strike against the oil refineries at Palembang in Sumatra. Taken PoW, he was treated brutally by his Japanese captors and, along with other Palembang raid survivors, was murdered at the end of the war. News of his death did not reach his family until early 1946.

Publication of this information will set the record straight in our own pages, at least — and will, we hope, serve as a salute to two naval aviators who lost their lives in tragic circumstances. **MO**

■ *With additional thanks to Jack Haberfield's sister Koa Murdoch, and to* TAH *reader Adrian Vicary*

AIR CORRESPONDENCE *Letters to the Editor*

Remembering RTR — 1

SIR — I was most saddened to read that Richard Riding had died *(TAH27)*. I am sure you're inundated with letters about him, and I would not feel right without putting my bit in to you.

I first got in touch with Richard many years ago when I wanted some photographs from his (father's) photo collection. When I mentioned that I wanted a set of his Comper Swift pictures he rang me to ask why. Then followed a long telephone conversation about Comper and Swifts. At that time I was gathering material for a possible book on Pobjoy aero-engines. It turned out we had similar aspirations, with Richard interested in Comper and me in Pobjoy. However, Richard suggested that, as he was busy with *Aeroplane Monthly* and other projects, that I put something together on the Comper/Pobjoy and we would take it from there, with a possibility of a dual-authorship book.

There followed many long phonecalls, mostly at night, on the subject, culminating in visits to his home to iron out some historical details. We agreed that a book about Comper/Pobjoy, while desirable, would be a complicated story — the result of our dreams. The project went on for a while then quietly, owing to complications of work and getting the material together, it joined other projects on the back shelf. However, we both agreed to add to it as and when new material surfaced, and to stay in touch.

At that time I was also involved in helping Don Cashmore with his idea of a scratchbuilt Comper Swift. Don had already group-built a Luton Minor and his own original Bristol M.1, Sopwith Tabloid and Hawker Cygnet. His work defies description. Don had located most of the original Comper drawings but had not had much success with Pobjoy manuals. I lent him my collection. I saw Don quite regularly as we were both in the Merlin Flying Club, based at Hucknall (now alas no more). Don used the group's Jodel for work-flying down to Bristol, then claiming fuel on expenses! We planned to fly down and see Richard but he was always too busy.

Anyway, that's enough. *TAH* is a an aeronuts' delight, always something of interest and technical as much as the enthusiast wants. Keep up the good work; it is really appreciated.

Bill Harrison *Derby, Derbyshire*

Remembering RTR — 2

SIR — I feel I must write and thank you for your tribute to Richard T. Riding in *TAH27*. I first met Richard in 1960 when I came out of the RAF and got a job at Elstree as an engineer with the London School of Flying. I soon got to know the lanky young lad who emerged from the dark recesses of the hangar, camera in hand, whenever an interesting aeroplane landed.

We formed a strong friendship, sharing many interests and the same sense of humour. I always

AERIAL MILESTONES Wall calendars for 2020 . . .

TIME FLIES ever more rapidly, and with weeks to go until 2020 here are some historic-aviation calendars — both of whose creators mark publishing milestones this year — that will aid planning and provide adornment. The two large (20in x 14in) GHOSTS calendars, by veteran air-to-air photographer Philip Makanna, feature World War Two and World War One subjects respectively (the former, incredibly, is in its 40th year; the latter is dedicated to renowned historic-aircraft collector Javier Arango, who died in 2017). Order them for $15.99 + p&p apiece from www.ghosts.com or GHOSTS, 665 Arkansas St, San Francisco, CA 94107, USA. The smaller one (8¼in x 11¾in) is the Cross & Cockade International calendar, now in its 20th year, featuring paintings of World War One subjects by 12 artists. It is available for £11 inc p&p (UK), £12.50 Europe and £13.50 RoW, ordered direct from www.crossandcockade.com. Profits from the calendar support the upkeep of the British Air Services Memorial at St Omer.

Brian Turpin (see his letter, adjacent) sent us this photo, taken at Elstree in 1961, showing the late Richard T. Riding holding the wing of David Greenland's Tipsy Nipper while Derick

looked forward to visiting the family home in Hendon to see his lovely mum and look through the numerous albums of his father's pictures. Richard photographed almost every aircraft that presented itself to him; this inspired me to do the same, so that when I obtained my commercial pilot's licence and went off to fly professionally I always had a camera in my flight bag. We went to many airshows together, often with special treatment thanks to his contacts at *Air Pictorial*, and twice he got me a ticket to photograph from beside the runway at Farnborough — memorable experiences which I greatly appreciated.

We started exchanging negatives but, as I was using 35mm and he preferred medium-format, he gave me a camera. I would then take two of everything and he did the same for me. Incidentally, the photo of Hispano Buchón G-AWHH on page 53 is an example. It was actually taken by me at Lydd on August 15, 1968, when two Casa 2.111s (Spanish Heinkel He 111s), two Buchóns and a Spitfire came in for fuel. I only point this out knowing what a stickler for accuracy Richard was and you are.

Brian Turpin *Saffron Walden, Essex*

Something for the weekend

SIR — Peter J. Marson's article in *TAH28* about Howard Hughes and the Lockheed Constellation brought back good memories. Back when I was still lucky enough to own Rearwin Cloudster G-EVLE, Ken Rearwin (the "Ken" of Ken Royce engines and son of Rearwin Airplanes founder Rae) invited me to the 2000 Farnborough Airshow.

During a long and fascinating conversation, he told me that, following the ultimately disastrous sale of Rearwin to Commonwealth, he went to work for TWA and that he was on at least one of Hughes's test flights on the Connie "borrowed" from the military and repainted in TWA colours.

Since Hughes would not waste a test flight, he also filled the aircraft with press and a good proportion of the board of TWA and then flew out over San Francisco Bay to test deep stalls!

As Ken told me, if you understand pre-stall buffet on a small light aircraft you can imagine what the buffet was like on a high-tech airliner of the 1940s. It was a far from pleasant experience for many of the passengers; there was much greening of faces, and the subsequent "fallout".

Ken said how stupid he thought it was to risk so many important people when things may not have gone as expected; nevertheless, the Connie had the good grace not to drop a wing.

Ken also told me a great tale. Hughes would use a fixed-base operator (FBO) at Los Angeles who rented him a Fairchild 24 at the weekend so that he could fly out whichever lucky starlet was that weekend's *liaison amoureuse* to Las Vegas. Inevitably, Hughes would be called back and so would travel commercially back to Los Angeles leaving the Fairchild (and possibly the starlet) behind. One of the FBO staff would then be required to travel to Las Vegas to collect it, ready for the following weekend. Ken told me he was pretty sure that that single rental covered the FBO's outgoings completely, and everything else they did was profit as a result!

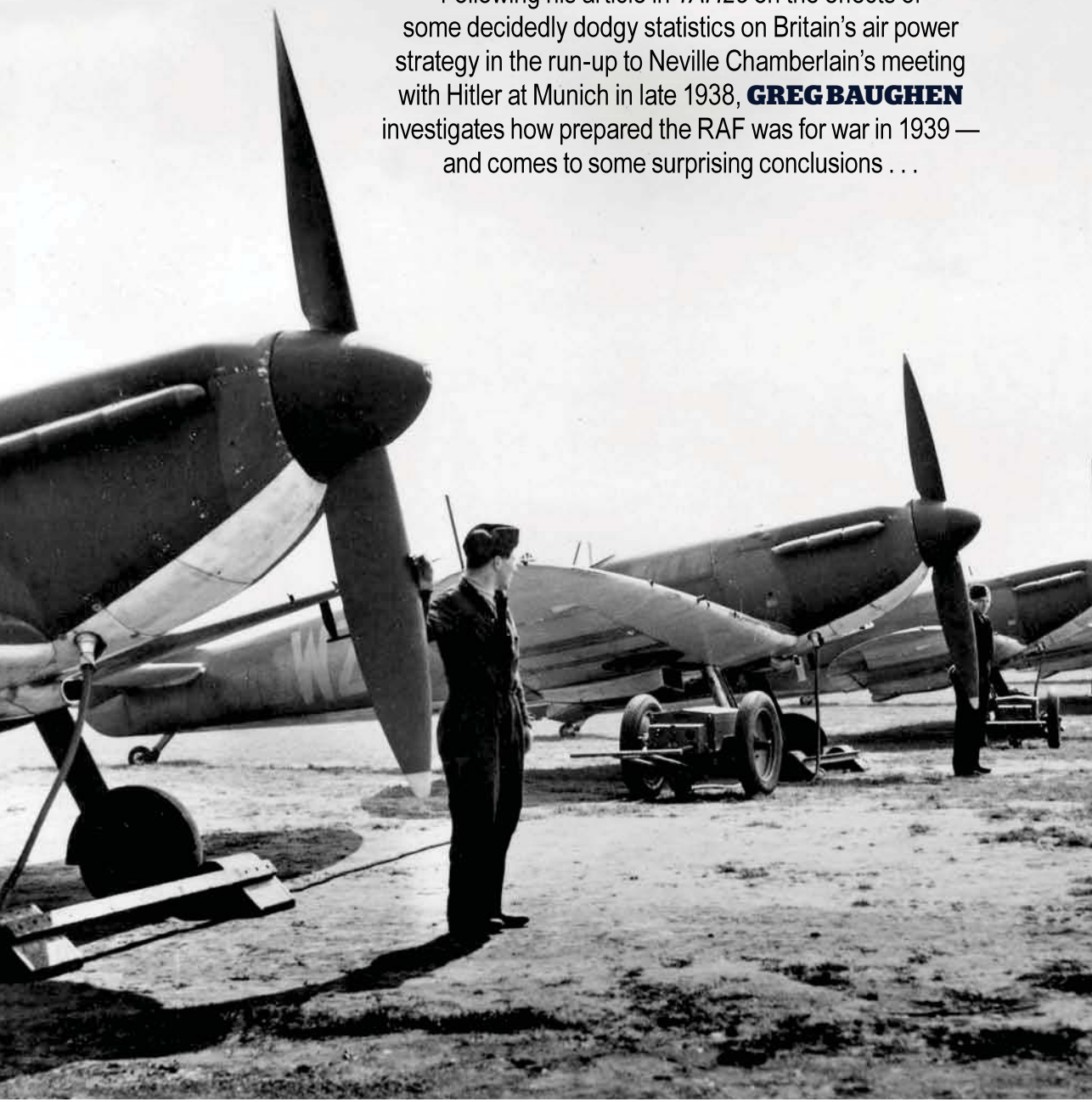
Keep up the good work, chaps.

Melvyn Hiscock *Southsea, Hampshire*

1939

Was the RAF ready for war?

Following his article in *TAH25* on the effects of some decidedly dodgy statistics on Britain's air power strategy in the run-up to Neville Chamberlain's meeting with Hitler at Munich in late 1938, **GREG BAUGHEN** investigates how prepared the RAF was for war in 1939 — and comes to some surprising conclusions . . .



TAH ARCHIVE x 2

ABOVE ***The Vickers Wellington entered RAF service in October 1938 and, although designed as a day bomber, formed the backbone of RAF Bomber Command's night raids during the early days of the war.***

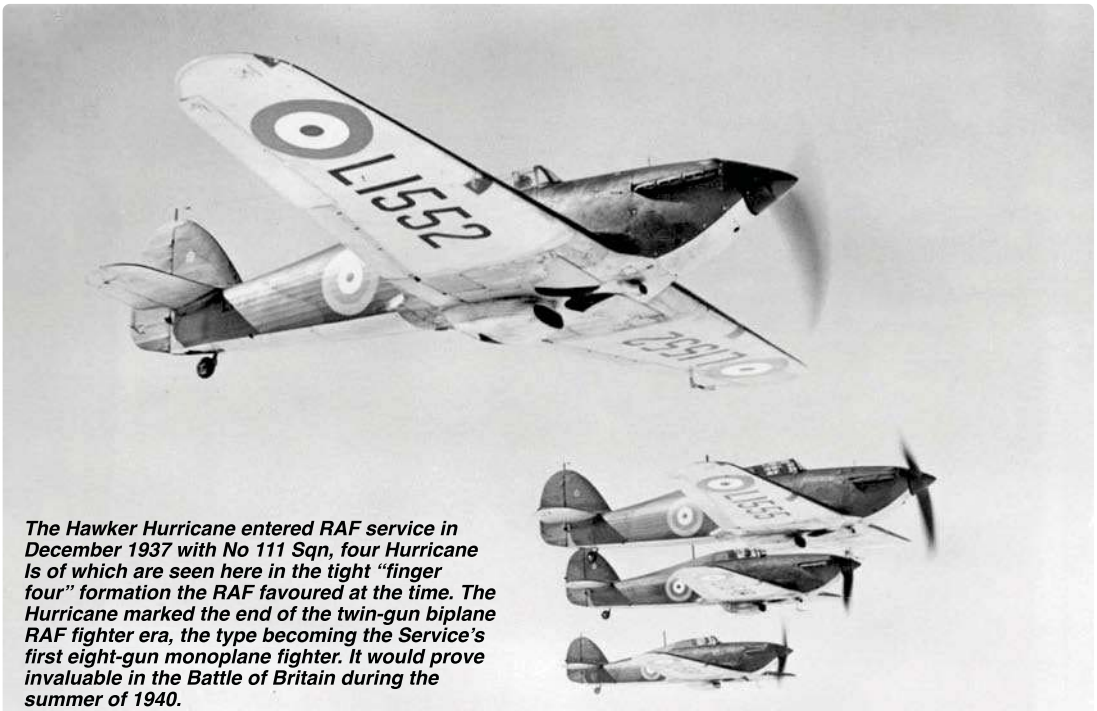
MAIN PICTURE ***Supermarine Spitfire Is of No 19 Sqn at Duxford in 1939. Note the wooden two-bladed fixed-pitch propellers; variable-pitch props were reserved for bomber types, fixed-pitch props being deemed adequate for bomber-interceptors.***

WHEN WAR WAS declared on Germany by Britain and its dominions in September 1939, it seemed that the time bought by Prime Minister Neville Chamberlain at Munich in September 1938 had been well spent. *[See the author's* The Case for Appeasement? *in* TAH25 *— Ed.]* The RAF was now much better prepared for war — but was it prepared for the right war?

Things to come . . .

The experts had left nobody in any doubt about what would happen when war was declared. It was predicted that hostilities would begin with an all-out aerial offensive against British cities and people, with the death toll expected to reach tens of thousands each day. It was this frightening prospect that had forced Chamberlain to accept peace at any price in Munich the year before. At that time, Britain had seemed almost defenceless. There was only a handful of radar stations to give warning of the incoming bomber armada, and these covered only the approaches to London. By September 1939, however, the chain of stations extended from Southampton on the South Coast to the north of Edinburgh in Scotland, with more covering Scapa Flow. Any bomber approaching Britain would be picked up while it was still 100 miles (160km) from the coast.

In September 1938 the only modern monoplane fighter in front-line RAF service had been the Hawker Hurricane, and this equipped only five squadrons. Deliveries of the Supermarine Spitfire to No 19 Sqn had begun, but by the end of September 1938 only seven had been taken on charge by the RAF, and the few that had reached the unit were grounded with teething problems. The remaining forces had consisted of a motley collection of biplanes including single-seat Hawker Fury IIs, Gloster Gauntlets and Gladiators, and seven squadrons of two-seat Hawker



The Hawker Hurricane entered RAF service in December 1937 with No 111 Sqn, four Hurricane Is of which are seen here in the tight "finger four" formation the RAF favoured at the time. The Hurricane marked the end of the twin-gun biplane RAF fighter era, the type becoming the Service's first eight-gun monoplane fighter. It would prove invaluable in the Battle of Britain during the summer of 1940.

TAH ARCHIVE

Demons. By September 1939 the Demons, Furies and Gauntlets had gone and there were 16 Hurricane units and 11 Spitfire squadrons.

Interceptors, not dogfighters

Both the Hurricane and Spitfire were designed as bomber-interceptors that could be used by day or night. It was assumed that bombers setting off from bases in Germany would not be escorted by fighters, so how the Spitfire and Hurricane would deal with enemy fighters was not a major consideration in their design. Both had relatively large wings to keep landing speeds low for night operations. This restriction, however, made it more difficult to achieve high speed and, indeed, the Hurricane was not particularly fast. Nevertheless it had ample speed to catch contemporary bombers. The Spitfire was in a different class with a remarkable top speed in excess of 350 m.p.h. (560km/h).

Fighter Command pilots were well-practised in tight formations, specifically designed to concentrate fire and overwhelm the defences of the massed ranks of attacking bombers, and more specialist "bomber-destroyers" were on the way. Fitted with a four-machine-gun electrically operated turret, the Boulton Paul Defiant would be able to fly parallel to an enemy bomber stream, taking up a position against which the enemy defences were least effective, and then pour uninterrupted fire into the enemy formation.

A major problem with all these interceptors was their relatively weak firepower. Rifle-calibre (0·303in) bullets were not going to be good enough against the four-engined bombers it was thought the Luftwaffe would inevitably throw at Britain's defences. Cannon with explosive shells would be far more effective. Britain had been slow to adopt the cannon, partly because the Air Ministry (AM) felt it had to follow the letter of international law. A 20mm-calibre shell was the smallest that could contain a useful quantity of explosives. However, the 1868 St Petersburg convention had banned the use of explosive shells as anti-personnel weapons because of the unnecessarily horrific wounds they inflicted. Under this convention no shells below 400gm (0·8lb) could contain explosives, which effectively ruled out any cannon below 37mm. This left British aircraft designers trying to incorporate unwieldy 37mm cannon into their fighter designs. *[See Mark Russell's* Bring Out The Big Guns *in* TAH28 *— Ed.]*

Most nations, however, were ignoring this ruling for fighter armament on the reasonable grounds that the weapon was aimed at the structure of the aircraft, not the crew, so they could claim to be staying within the spirit of the convention. The French had developed the excellent Hispano-Suiza HS.404 20mm autocannon. It was still a hefty weapon — it weighed five times more than a Browning machine-gun — but offered seven times the weight of fire, considerably greater range and the shells were explosive. The AM issued specifications for fighters able to mount no fewer than four of these formidable weapons. Instead of eight machine-guns, RAF fighters of the future would potentially have the equivalent firepower of 28 such weapons.

LEFT ***Designed to Air Ministry Specification F.37/35, the Westland Whirlwind was the first single-seat twin-engined fighter to see RAF service, the first production examples being delivered to No 263 Sqn at Exeter in December 1940. The type's four fixed forward-firing 20mm cannon in the nose offered an excellent concentration of considerable firepower, although it never quite overcame early teething troubles and was later used in the fighter-bomber role.***

PHILIP JARRETT COLLECTION

BELOW ***Air Ministry Specification F.11/37, issued in May 1937, called for a twin-engined two-seat fighter fitted with four 20mm cannon in a power-operated turret. A contract was placed with Boulton Paul for the P.92, a half-scale model of which was built by Heston Aircraft as the P.92/2, serial V3142, seen here. The dome atop the fuselage represented the outline of the wide-diameter low-profile turret.***

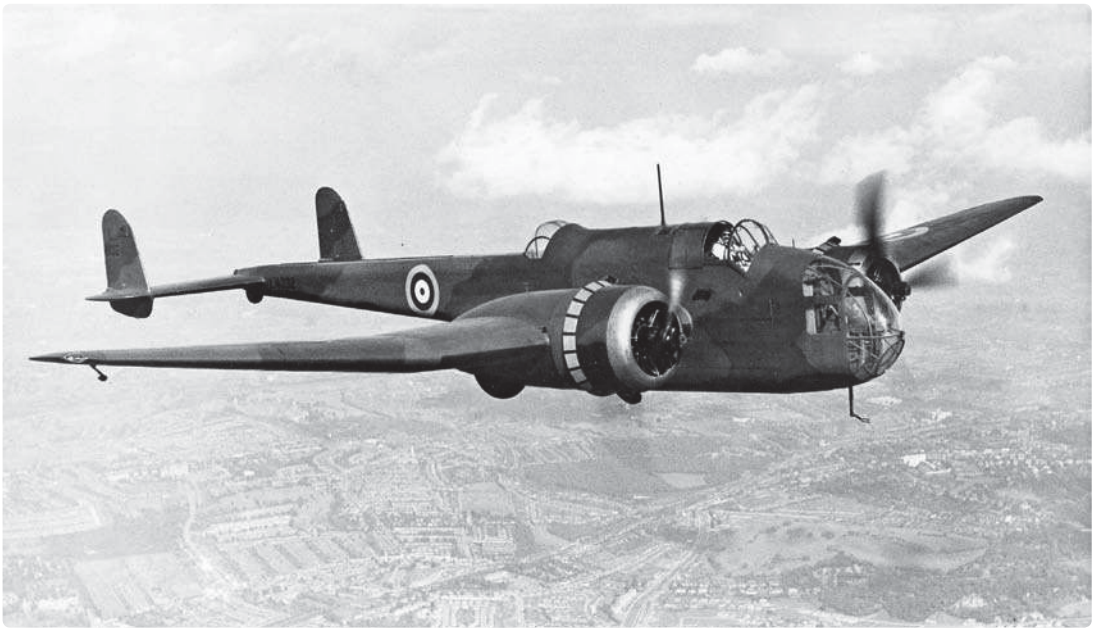
The weight of the cannon and their powerful recoil, however, made it difficult to mount them in the wings of a fighter, so designers turned to twin-engined designs with the cannon grouped in the nose. The first of these was the Westland Whirlwind, designed to Specification F.37/35, followed by a proposal from Bristol for a "Beaufort fighter" which became the Beaufighter. When war broke out, only prototypes of both had flown, but both had already been ordered into production. It was hoped to replace the Hurricane and Spitfire as quickly as possible. The Supermarine works in Southampton was already earmarked to build Beaufighters instead of Spitfires.[1]

Fighters with even heavier offensive armament were on the way. Specifications had already been released for twin-engined interceptors armed with 40mm cannon and possibly air-to-air rocket projectiles. High priority was attached to Boulton Paul's twin-engined P.92 successor to the Defiant, which was to mount four 20mm cannon (or possibly one 40mm) cannon in its turret. The defences of the British Isles were far from ideal in September 1939, but Fighter Command and fighter development seemed to be moving in the right direction.

The bomber element

The RAF's Bomber Command was also in a far better position to launch the retaliatory strike that would inevitably be required. In the bomber-war scenario, the bombs an aircraft could carry were the measure of its value. In the autumn of 1938 the RAF's best day bombers, the Fairey Battle and Bristol Blenheim, could carry only 1,000lb (450kg) of bombs. A year later, however, some 17 squadrons were equipped with the Vickers Wellington and Handley Page Hampden, both of which were capable of carrying 4,000lb (1,815kg) of bombs.

TAH ARCHIVE



TAH ARCHIVE x 3

ABOVE ***The single-pilot Handley Page Hampden was dubbed "the flying suitcase" by*** **The Aeroplane's** ***Editor, C.G. Grey, owing to its extremely slim fuselage. Interestingly, a German intelligence assessment of the time rated the Hampden as the RAF's best bomber.***

LEFT ***The Hawker Henley, built to Specification P.4/34 for a high-speed monoplane light day bomber, was closely related structurally to its stablemate the Hurricane, and was essentially designed to bomb Paris. It was only ever used as a target-tug, however.***

Designed to Specification P.27/32 for a single-engined day bomber, the Fairey Battle entered RAF service in May 1937. Originally conceived as a bomber able to reach Paris, it was hopelessly ill-equipped to be able to shift its focus to targets in Germany; as a strategic bomber it was an abject failure — but it had potential as a short-range tactical bomber.

TAH ARCHIVE

ABOVE ***The twin-engined Avro Manchester was designed to fulfil Specification P.13/36 for a medium bomber "for worldwide use". The prototype made its maiden flight on July 25, 1939, and the type entered RAF service in November 1940; its Rolls-Royce Vulture engines were troublesome, however, and it was withdrawn in June 1942.***

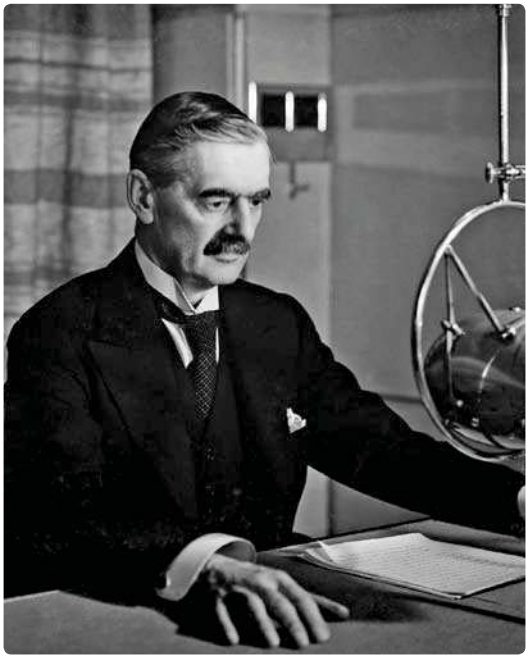
These were without doubt excellent contemporary designs; no more could be expected from mid-1930s technology. In the heavy-medium bomber category, the Wellington had a similar performance to that of the Luftwaffe's Heinkel He 111. In the light-medium category the Hampden was at least a match for the German Dornier Do 17. By the standards of 1939, the Wellington and Hampden were both reasonably well-armed. Both were expected to be able to fly unescorted by day deep into German territory. Of the two, the Wellington was considered the better long-range bomber. It was slower than the Hampden, but there was great confidence that its power operated nose- and tail-turrets would vanquish any interceptors that dared oppose it. The Wellington crew also included a copilot, a major advantage on long-distance sorties. The much smaller Hampden had space for only a single pilot.

Fairey's Battle, with its limited bomb load and single hand-held rearwards-firing machine-gun, was looking ever more like a terrible mistake. The AM's predilection for single-engined bombers had always been a suspect policy. The single-engined medium bomber — in the Airco D.H.4/Hawker Horsley/Fairey Battle lineage — and the high-speed light bomber — Fairey Fox/Hawker Hart/Hawker Henley — were comparatively inexpensive, but that seemed to be their only advantage. At least the AM had not persisted with the long-range light bomber. Remarkably, the Henley, with its paltry 500lb (225kg) bomb load, had been put into production after Germany replaced France as Britain's most likely potential enemy, even though it would struggle to reach any targets in Germany from bases in Britain. Almost immediately, the AM realised the error of its ways, reduced the contract and decided those built would be used only for towing targets. The Battle would serve on the front line, but many doubted it would be able to contribute much. The sooner it was removed from service the better. The Blenheim, with its limited bomb load, was not considered much better and it was hoped to get rid of this as soon as possible as well.

When war broke out, Bomber Command could lift around 700 tons of bombs into the air by day. By night its twin-engined Armstrong Whitworth Whitleys could add another 100 tons. The total bomb lift was still below the 1,500 tons it was believed the Luftwaffe was capable of carrying, but the RAF would be able to mount a reasonable response to any German aggression, plus there would be a French contribution to boost it. Once the entire day-bomber fleet was equipped with Hampdens and Wellingtons, the bomb lift would be around 1,300 tons, and better bombers were on the way. The twin-engined Avro Manchester and four-engined Short Stirling had flown, and the Handley Page Halifax was about to fly. The Manchester would be able to carry twice the bomb load of the Wellington and Hampden, and the Stirling and Halifax nearly four times as much. As with its fighter counterpart, Bomber Command seemed to be going in the right direction.

Bleak expectations

At 1115hr on September 3, 1939, Neville Chamberlain told the nation it was at war. The previous few days had seen a frantic evacuation



LEFT ***On September 3, 1939, Prime Minister Neville Chamberlain announced to the nation that Britain was at war with Germany: "It is evil things that we shall be fighting against — brute force, bad faith, injustice, oppression and persecution — and against them I am certain that the right will prevail . . ."***

of city centres. Some 5,600 inmates were released from prison and 140,000 patients were sent home, many with serious but curable conditions, to make way for the expected flood of casualties. It seemed Hitler was not wasting any time. Almost as soon as Chamberlain had stopped speaking, the air-raid sirens wailed. Everybody knew what to expect. Politicians, self-appointed experts and science-fiction writers had spent the previous two decades describing the apocalyptic nightmare future bombing wars would bring.

The sirens wailed but the bombers did not come. The alert had been caused by a French aircraft making its way to Croydon Airport. The first day of war passed without the dreaded "knockout blow". So did the second day. Perhaps the Luftwaffe was still too busy in Poland. However, even when Poland surrendered, there was still no attack. Christmas came and went and a new year began with still no sign of the predicted firestorm from above.

As we now know, Germany had no intention of launching such an attack. Indeed, its bomber force was not capable of delivering a worthwhile blow from airfields in Germany. The knockout punch for which the Air Ministry had spent two decades preparing was not even feasible. Bombers alone could not decide the outcome of a war. Britain had spent millions of pounds preparing for the wrong war.

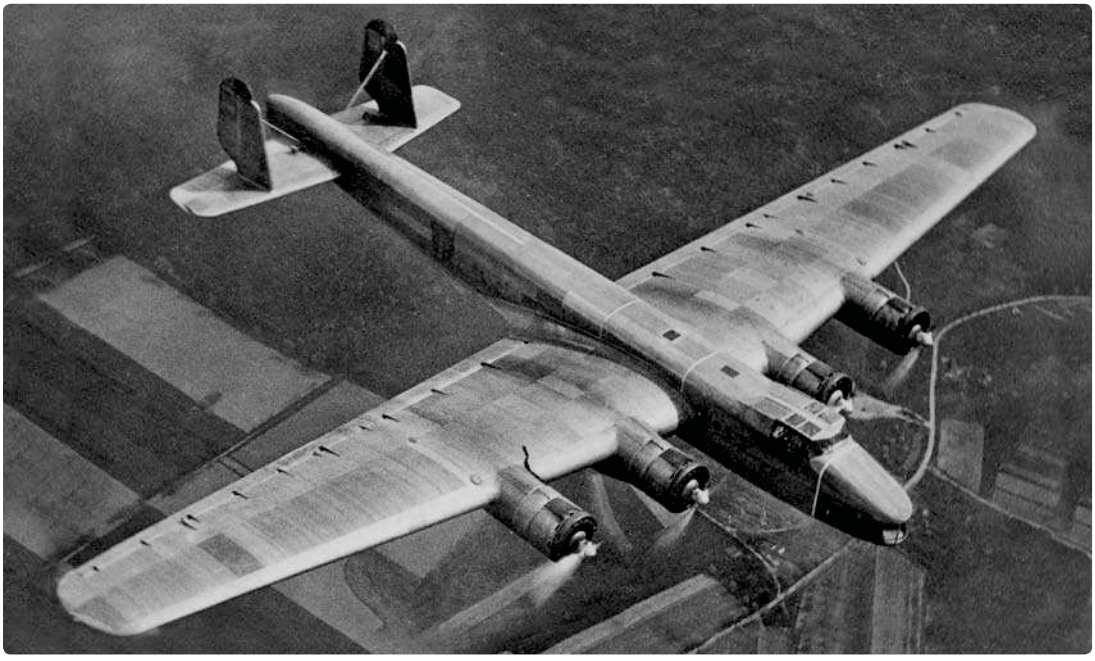
Strategic versus tactical

So what sort of war should Britain have been preparing for? Following the First World War, the priority was to avoid the horrors of static trench warfare. There were two competing theories for how future wars would be fought. One approach was not to fight battles on land at all. Instead, the issue would be decided entirely by air forces. Countries would attempt to bomb each other into submission. It would be brutal and many civilians would die, but at least it would be over quickly — or at least that was what its advocates claimed.

This theory is generally associated with the writings of Italian general and air power pioneer Giulio Douhet. He did not invent the strategy; the idea had taken root long before his ideas were published in the 1920s. His writing merely reflected a commonly held view at the time. Douhet had absolutely no influence on British inter-war thinking on air power; indeed, his books were not published in Britain until 1942.

In the UK, theories about bomber wars and the fears they aroused had been around for some time. Indeed, they had been given voice before

BELOW ***The Short Stirling, designed to Specification B.12/36, was the first four-engined monoplane bomber to enter RAF service, and the first to be used operationally in wartime. It was considered such an outstanding design that it was proposed in 1940 to send one to the USA to give American designers an idea of what could be achieved.***
TAH ARCHIVE



TAH ARCHIVE

ABOVE ***Bearing something of a resemblance to the Stirling, the German Dornier Do 19 "Ural Bomber" was exactly the sort of four-engined long-range strategic bomber British planners were expecting in droves over the UK should war break out. The Germans felt it was more important to focus on tactical fighters and bombers, and cancelled the Do 19 in April 1937.***

the "Father of the RAF", Hugh Trenchard, had even climbed into an aeroplane. Before the First World War, it was the Zeppelin that had provoked fear in the minds of politicians and public.[2] During the Great War, Zeppelins and then Gotha biplane bombers had underlined how real that threat was. The RAF was created to develop this strategic application of air power. *[See the author's* New Model Air Force *in* TAH23 *— Ed.]*

There was, however, an alternative — predominantly tactical — approach. This involved using the internal combustion engine to allow mobility to return to the battlefield. With tanks supported by motorised infantry, breakthroughs and rapid advances would once again become possible. In Britain Col J.F.C. "Boney" Fuller and Brig Percy Hobart were among the leading advocates of this new style of mechanised warfare.

These two competing theories were always going to require a choice to be made. Neither mechanised armies nor strategic bomber forces are cheap. Even comparatively wealthy countries like Germany and Britain could not afford both. Politicians often mistakenly saw this as a choice between investing in the air force and investing in the army. In fact, whichever approach a country adopted, a powerful air force would be required. Mobile forces were vulnerable to air attack and would be in need of protection. Battlefield commanders needed to know what their opponents were doing and in turn needed protection from the prying eyes of the enemy. The artillery would not always be able to keep up with the advance; support by bomber aircraft provided a substitute. Air support was an integral part of mechanised warfare. Both the bomber and mechanised-army approach required powerful air forces, but each required a very different type of air force. And the smaller aircraft required for tactical air support were much more affordable.

During the inter-war years, all countries were affected by the bomber nightmare, but democracies like France and Britain were affected the most. In democracies, where politicians have to pay attention to what people think, public fears feed into the national political debate more readily. In the 1930s, politicians needed to reassure the electorate that the country had the means to defeat or deter aerial attack, and national defence policy was shaped accordingly. In totalitarian states (Germany, the Soviet Union, Italy, Japan) public opinion had less influence on military thinking, and the policies adopted were more militarily pragmatic.

Britain and Germany had made their choices. Successive British governments had decided the country could not afford a large army, a huge Royal Navy and an expensive bomber force. By 1938 "limited liability" was official government policy. Britain would support any future ally with sea and air power only. Germany took a different course. While Britain was issuing Specifications B.12/36 (what would become the Stirling) and P.13/36 (Manchester) for the next generation of heavy bombers, Germany was cancelling its plans to build the four-engined Dornier Do 19 and Junkers Ju 89. Hitler and his planners had

TAH ARCHIVE x 2

LEFT ***Bristol's Blenheim medium bomber was developed from the company's civil Type 142 high-speed transport and entered RAF service in March 1937. It was fast and comparatively cheap — the man-hours required to build a single Short Stirling could produce more than three Blenheims.***

BELOW ***Spitfires of No 92 Sqn at Pembrey in South Wales in the autumn of 1940. Note the constant-speed three-bladed propellers — an improvement which helped turn the type from a basic bomber-interceptor into a world-class air superiority fighter.***

decided that Germany could not afford to build a huge force of strategic bombers as well as its Panzer armies, and opted for the latter. The way warfare developed in the decades that followed demonstrated that Germany had made the right decision. The Second World War turned out to be a tactical tank war, not a strategic bomber war. The war would be decided on the battlefields of Europe, not in the skies over capital cities. Armies would expect bomber support; fighter would have to take on fighter over the battlefield, as they had in the First World War.

Even before the outbreak of war, pressure was applied to the RAF to change tack. In March 1939 the government officially abandoned its "limited liability" policy. Conscription was introduced and Britain began creating an army to fight on the Continent. It was not a military judgment on how sound "bomber theory" was, it was more of a political reality. Britain had just entered into an alliance with the French; simply blockading and bombing Germany was not going to be enough to satisfy its new ally. Britain had to put "boots on the ground". If Britain was building an army, it had to build an air force to go with it.

British and French army generals were soon demanding to know how the RAF intended to support their forces. The Air Staff insisted that the RAF's main focus had to remain the bomber war. But when war was declared, there was no knockout blow; there was nothing for Fighter Command to defeat and nothing for Bomber Command to respond to. The Air Ministry also had to concede that there was no evidence from the campaign in Poland that the Luftwaffe had made any attempt to defeat Poland by "terror bombing". Similarly, reports from the Spanish Civil War (1936–39) had indicated that air power had, for the most part, been used tactically.[3]

Early Bomber Command raids were soon demonstrating that even the Wellington was not capable of penetrating enemy airspace without suffering heavy losses. The RAF was discovering what the Luftwaffe already knew; the sort of unescorted daylight bombing offensive the Air Staff had planned was not possible. Germany's *Wehrmacht*, on the other hand, was demonstrating that armoured forces with air support did work. Mechanised warfare was producing stunning and remarkably rapid victories.

1939: Luftwaffe vs RAF – how they compared Compiled by Greg Baughen

	Speed	Range	Bomb load/armament
Junkers Ju 87 Stuka	238 m.p.h. (383km/h)	350 miles (560km)	1,300lb (590kg)
Fairey Battle	240 m.p.h. (386km/h)	1,050 miles (1,690km)	1,000lb (454kg)
Dornier Do 17Z	255 m.p.h. (410km/h)	720 miles (1,160km)	2,000lb (907kg)
Handley Page Hampden	254 m.p.h. (408km/h)	1,500 miles (2,400km)	4,000lb (1,814kg)
Heinkel He 111H-3	236 m.p.h. (380km/h)	1,740 miles (2,800km)	4,400lb (1,995kg)
Vickers Wellington IA	234 m.p.h. (377km/h)	1,600 miles (2,580km)	4,500lb (2,041kg)
Henschel He 126	221 m.p.h. (355km/h)	620 miles (1,000km)	330lb (150kg)
Westland Lysander	230 m.p.h. (370km/h)	600 miles (970km)	580lb (263kg)
Messerschmitt Bf 109E	354 m.p.h. (570km/h)	412 miles (660km)	2 x 20mm cannon + 2 x machine-gun
Supermarine Spitfire IA	365 m.p.h. (587km/h)	575 miles (930km)	8 x machine-gun

In this new scenario, Fighter Command would no longer be Britain's first line of defence. The threat to Britain would not come through the air from Germany over the North Sea; it would come across land through the Low Countries and France. Fighter Command would be too far from the crucial battles to play any part in them. If there was no knockout blow against Britain, there would be no justification for using Bomber Command against targets in Germany. Indeed, there would be very little justification for keeping much of the RAF in Britain; its aircraft would be needed where the war was being fought.

How prepared was the RAF?

This meant the RAF would be operating in a very different environment. Nobody expected enemy fighters to operate over Britain, but it would be very different over the battlefield. Being within easy reach of enemy fighters meant that the tactics the RAF's fighter pilots had become familiar with would become a formula for disaster. When intercepting unescorted bombers, there was no need to worry about what might be behind. The tight formations they had learnt to fly were ideal for concentrated attacks on bomber formations, but made it difficult to look out for the enemy. The pilot's priority was not to collide with the fighter next to him.

Nor were the fighters they were flying ideal for their new role. The Hurricane was adequate as a bomber-destroyer, but it lacked the speed necessary to take on the Messerschmitt Bf 109E on equal terms. Even the Spitfire was not ideal. Rapid manœuvring at high speed was not something it was designed to do. The type's comparatively large wings were ideal for low landing speeds, but with rate of roll varying with the fourth power of the span, larger wings significantly reduce a fighter's agility. The Rolls-Royce Merlin engine had a tendency to cut out if the nose was put down too quickly. The type was also difficult to manœuvre at high speed. None of these shortcomings had previously caused any concern, because they were not problems for a bomber-interceptor that only had to fly straight and level. But they were problems for a dogfighter.

Nevertheless, even with these disadvantages, the Spitfire was still a formidable tactical fighter, especially as its chief opponent, the Bf 109E, was also something of a handful to control at high speed. The Spitfire's relatively weak armament would not be such a problem against smaller tactical aircraft; four 20mm cannon were not needed to shoot down a Junkers Ju 87 Stuka dive-bomber or Bf 109. One or two cannon would be useful, but the weight of four would substantially reduce manœuvrability and potentially be a handicap. The Whirlwind and Beaufighter interceptors had the additional disadvantage of being twin-engined and would be at a hopeless disadvantage in a dogfight. The Defiant, weighed down by its bulky turret, would also struggle. The RAF, however, was extremely fortunate; the Whirlwind, Beaufighter and Defiant were all well behind schedule. None had entered service yet. There was time to adjust production schedules.

Regarding bombers, if the Wellington and Hampden were going to be used only against short-range tactical targets, they would not need to rely so heavily on their defensive armament. Fighters could accompany them. With a fighter escort, the Hampden and Wellington would be no more vulnerable than the He 111s and Do 17s the Luftwaffe was using to support German ground forces. Of the two British types, in a tactical role, the faster Hampden was now much the better option. The single pilot was not a disadvantage

TAH ARCHIVE

ABOVE ***The Westland Lysander was designed to Specification A.39/34 for a two-seat Army co-operation aircraft, the prototype making its first flight in June 1936. The "Lizzie" entered RAF service in May 1938 and served throughout the war in an impressive variety of roles including reconnaissance, air-sea rescue and spy-dropping.***

on shorter-range missions, and the aim now was to get out of enemy airspace as quickly as possible, not take on and defeat Messerschmitts.

In this new scenario, the Fairey Battle had a much brighter future. It was the only bomber the RAF had that was manœuvrable enough to undertake low-level strike sorties. Fairey engineers and the AM were already looking into the possibility of removing the auxiliary fuselage tank and adding armour instead, to protect the aircraft and its crew from groundfire. Four wing-mounted machine-guns for ground-strafing were also being considered. With a French self-sealing fuel tank system lined up for the bomber, it could yet become a formidable ground-attack machine.[4]

The smaller, more agile and faster Hawker Henley might be even better. A limited number was being built as target-tugs, but there was no reason why it could not revert to its original light bomber role and stay in production. The Beaufighter and Whirlwind might not have much to offer as fighters, but with four cannon they might make excellent ground-attack aircraft. The gods seemed to be smiling on the RAF. The AM had been developing the right aircraft for the wrong reasons.

A "specialist jack-of-all-trades"?

There was also the Westland Lysander. This was the sort of machine the AM had wished it did not have to build. Any aircraft built for the Army would just be one less for the crucial bomber war. With the government wanting no more than a token army, the AM saw no reason why it should waste any aircraft on Army needs. If the Army had to have anything then it should be a single type that could do everything the Army might want: dive-bombing; low-level ground attack; reconnaissance and artillery observation. This, the AM proudly proclaimed, was a specialist Army-support aircraft. It was actually more of a "specialist jack of all trades" — a contradiction in terms. However, if it was not going to be a bomber war, it was exactly the sort of machine the Army would need. It was always going to be optimistic to expect a single design to perform such a wide variety of tasks. Nevertheless, with its excellent short take-off and landing (STOL) characteristics enabling it to operate from the smallest forward airstrips, it was a useful short-range tactical observation/reconnaissance aircraft. Arguably, the Lysander was too sophisticated and expensive for such a limited role, but it existed, it was in production and nobody would suggest it was in any way inferior to its German opposite number, the Henschel Hs 126.

Thus in September 1939 Britain had an excellent single-seat tactical fighter (the Spitfire), some useful light and medium bombers (Blenheim and Hampden), some potentially effective ground-attack aircraft (Battle, Whirlwind and Beaufighter) and a high-tech tactical reconnaissance aircraft (Lysander). More by luck than good judgment, the RAF had the aircraft to fight the war it found itself in. Indeed, arguably the aircraft the RAF possessed were better prepared for this type of war than the bombing war the Air Staff had been planning for.

The problem the RAF faced was more long-term than short-term. There were no twin-engined bomber replacements for the Hampden and Blenheim in the pipeline. The Hawker

Typhoon and Tornado were about to fly for the first time, but these were also designed to be bomber-interceptors, not air-superiority fighters. To replace the Typhoon/Tornado, the AM was favouring even less suitable heavily-armed twin-engined designs. For the future, some new thinking and fresh Specifications were required; but in the short term the aircraft that were available were remarkably suitable for providing the Army with the support it would need.

In September 1939 the AM was confident it was closing the gap in the bomber race. In fact there was no race. Germany had different priorities. While Britain was trying to build more and heavier bombers, the Germans were building tanks and tactical bombers. The question was not how quickly would Britain close the bomber gap — it was how quickly would the AM realise it was hurtling down the wrong path?

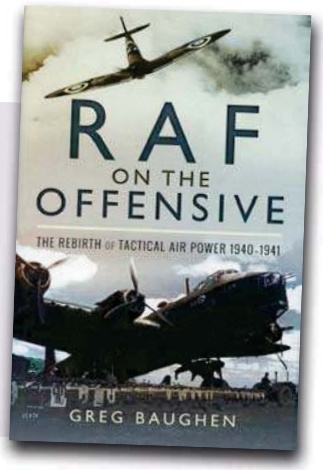
Saved by the war?

The war may have come just in time. Had it broken out a year or so later, it might have been too late to change course. The RAF would have been irrevocably committed to the mass-production of specialist bomber-interceptors and large long-range bombers. In the summer of 1939, however, there was still time to change direction.

By sheer good fortune, the RAF already had the aircraft it needed for the type of war that was unfolding — but could its commanders switch mindsets and accept that these aircraft should be used to support the Army? Could they grasp that they were in a very different kind of war from the one for which they had been planning for the last two decades?

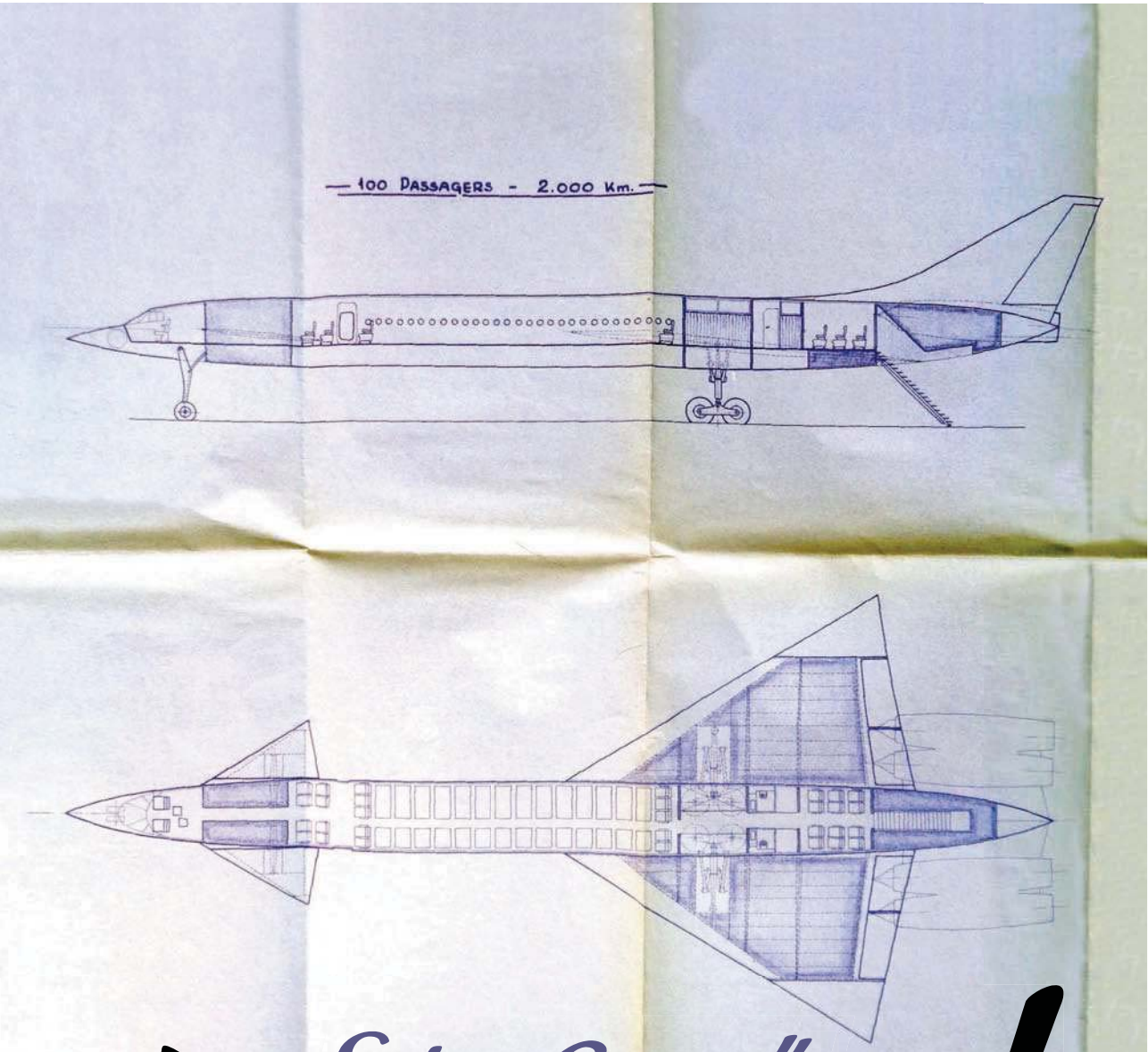
The Germans were hoping to launch a ground offensive in the West as soon as they had defeated Poland, but the weather intervened. With winter closing in, Hitler decided to wait until the following spring. The Air Staff would have eight months to rethink how the RAF should be used. Would it be long enough?

GREG BAUGHEN is the author of a series of books on the history of British air power, the latest of which is ***RAF on the Offensive*** (Pen & Sword, 2018). For more information visit **www.facebook.com/gregbaughen**



1 The National Archives ref AVIA46/66, October 14, 1939
2 Baughen, G., *Blueprint for Victory* (Fonthill Media, 2014), chapters 1–2
3 Baughen, G., *The RAF in the Battle of France and the Battle of Britain* (Fonthill Media, 2017) pp12–13, 35–37, 54–55
4 Baughen, G., *The Fairey Battle: A Reassessment of its RAF Career* (Fonthill Media, 2017)

GOERING AND HIS STAFF OFFICERS LOOK TOWARDS ENGLAND / TAH ARCHIVE



Super-Caravelle atomique!

FRANCE'S NUCLEAR-POWERED SST PROPOSAL, 1958

French aviation historian **JEAN-CHRISTOPHE CARBONEL** marks the end of the 50th anniversary year of the first flight of Concorde by taking a look at a brochure issued by Sud Aviation in March 1958 for a wildly ambitious nuclear-powered supersonic "Super-Caravelle", which — perhaps fortunately — never proceeded beyond the drawing-board

THE 1950s REPRESENTED a period of adventurousness and remarkable success in the world of aviation, particularly for France and its ambitious aircraft manufacturers. Dassault's Mystère II jet fighter had pushed through the "sound barrier" on October 28, 1952, and the French were now aiming at Mach 2, ultimately achieved in France for the first time by the Nord Griffon II on August 5, 1958.

Numerous advanced concepts, including delta wing configurations (as fitted to the SNCASE Durandal and Dassault Mirage), high-aspect-ratio wings (as per the Hurel-Dubois HD.31) and the annular wing (Snecma Coléoptère), were all built and tested. Having mastered the turbojet, thanks to the Atar team at Snecma, France also took up the challenge of ramjet-powered aircraft (the Nord Griffon) and rocket-powered interceptors (including the SNCASO Trident), so it was only a matter of time before the country began investigations into nuclear power for the propulsion of aircraft.

THE PEOPLE

In January 1956 Snecma established a *"division atomique"* under Raymond Marchal, the company's scientific director, who had spent two years at France's *Commissariat à l'Energie Atomique* (Nuclear Energy Commission) to get to grips with the new technology. Although Snecma's atomic division employed some 200 people, with a *bureau d'étude* led by Louis Meulien, it was activated only in 1958 and appears not to have made much progress towards its stated goal of building a flight-rated nuclear engine. Yet the fact that such an organisation was established illustrates the seriousness with which the idea was considered, even if the ability to achieve it was unproven.

It was in the brochure announcing the creation of the atomic division that a sketch was published of the rear of a Sud Aviation SE.210 Caravelle jetliner adapted to accommodate a nuclear powerplant. It is unlikely that this drawing represented more than an ambitious concept — but it is a pointer to later research.

By late 1957 Georges Héreil, President of the newly formed Sud Aviation — formed on March 1 that year with the amalgamation of SNCASE (Sud-Est) and SNCASO (Sud-Ouest) — had plenty of reasons to be cheerful. The Caravelle, which had first flown on May 27, 1955, was attracting considerable attention worldwide and sales contracts had been signed with Air France,

ANDRÉ CROS

Scandinavian Air System and Brazil's Varig. Considerable interest in the type had also been shown during a tour of the USA in April 1957, with Howard Hughes expressing a wish to build the aircraft under licence.

To take advantage of this success, Héreil tasked the Sud design office with exploring the creation of a family of aircraft based on the Caravelle. Some research had already been completed by Charles Parot's bureau d'étude (formerly part of SNCASE, the original design company of the SE.210) about turning the Caravelle into a supersonic aircraft. However, Héreil turned the project over to Lucien Servanty's design office (formerly part of SNCASO), as Servanty was Sud's resident specialist in high-speed flight.

THE PROJECT

In March 1958 Sud issued a *notice de présentation* (brochure) describing a *"Super-Caravelle, version à propulsion nucléaire"* — a Caravelle variant with a nuclear powerplant. The brochure was essentially "a first contact with the idea", but concludes that "this basic study shows no obvious impossibilities against the design of a nuclear-powered airliner".

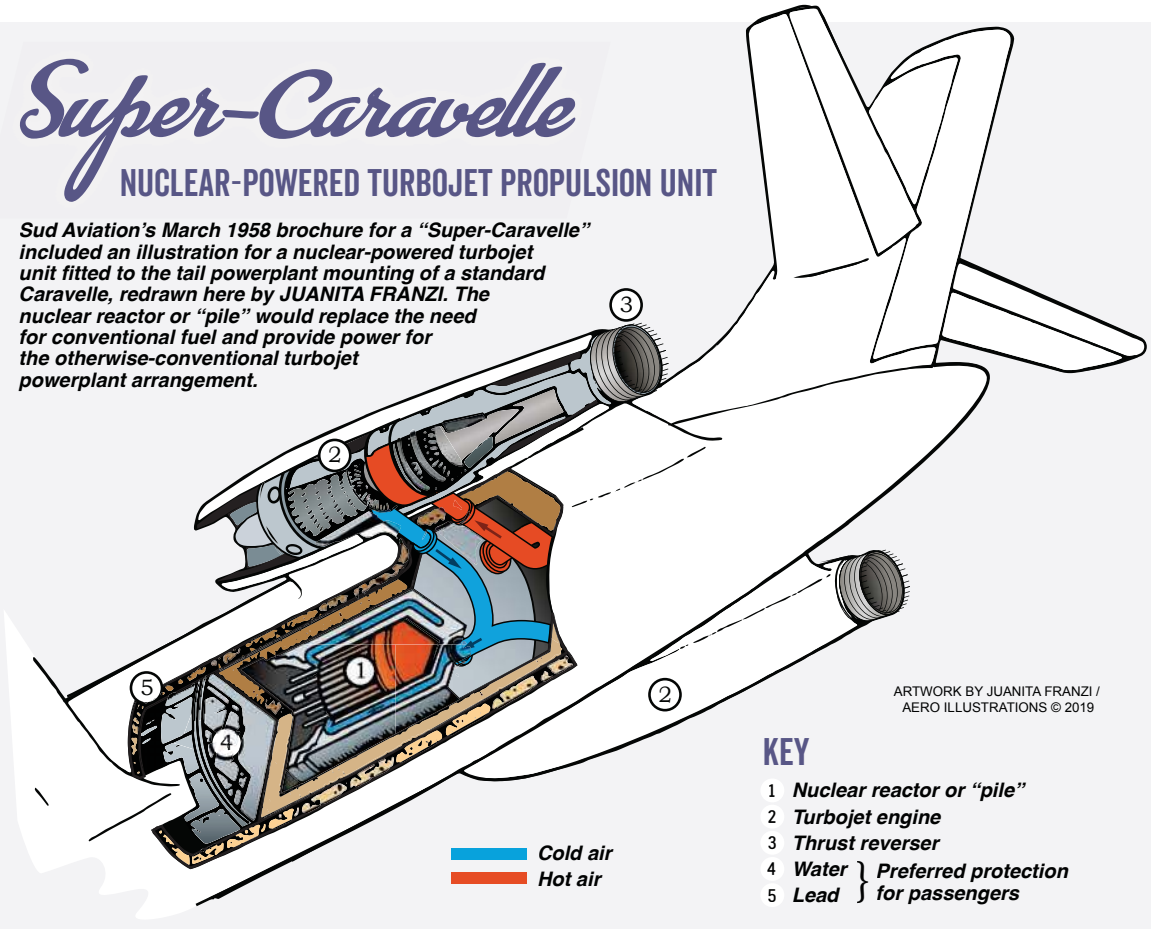
The brochure details the "Super-Caravelle" concept, designed by Lucien Servanty — as may be determined from the numbering and dates of

OPPOSITE PAGE ***The original 1958 dyeline for the conventional turbojet-powered "Super-Caravelle", on which it was proposed to base a version fitted with turbojets powered by an onboard nuclear reactor.*** **ABOVE** ***Lucien Servanty shows HRH The Duke of Edinburgh around a mock-up of Concorde in 1965.*** DYELINE AUTHOR'S COLLECTION

Super-Caravelle

NUCLEAR-POWERED TURBOJET PROPULSION UNIT

Sud Aviation's March 1958 brochure for a "Super-Caravelle" included an illustration for a nuclear-powered turbojet unit fitted to the tail powerplant mounting of a standard Caravelle, redrawn here by JUANITA FRANZI. The nuclear reactor or "pile" would replace the need for conventional fuel and provide power for the otherwise-conventional turbojet powerplant arrangement.



ARTWORK BY JUANITA FRANZI / AERO ILLUSTRATIONS © 2019

KEY

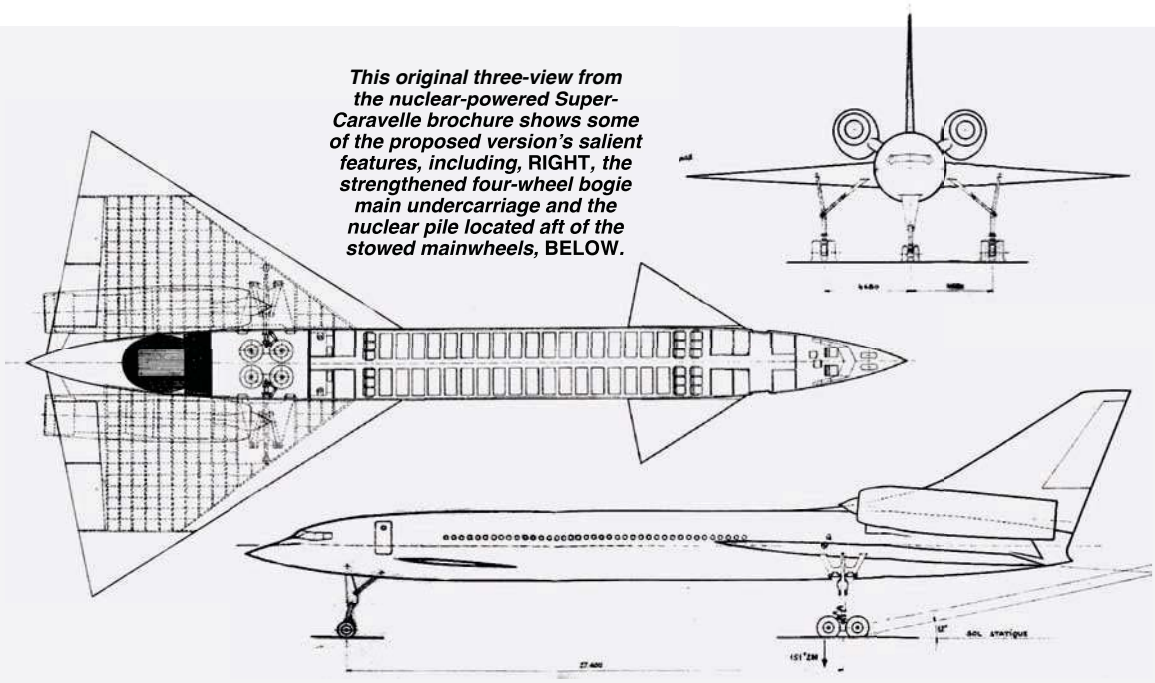
1 *Nuclear reactor or "pile"*
2 *Turbojet engine*
3 *Thrust reverser*
4 *Water* } *Preferred protection*
5 *Lead* } *for passengers*

the drawing (all are dated March 1958) supplied within the brochure. These are:
#**101** Super-Caravelle; conventional turbojets; three-view drawing;
#**102** Super-Caravelle; nuclear propulsion; three-view drawing;
#**103** Super-Caravelle; conventional turbojets; internal arrangements, 60 and 100 passengers;
#**104** Super-Caravelle; nuclear propulsion; internal arrangement;
#**106** Super-Caravelle; nuclear propulsion; passenger sections and luggage-bay volumes;
#**110** Super-Caravelle; nuclear propulsion; undercarriage;
#**112** Super-Caravelle; nuclear propulsion; cockpit.

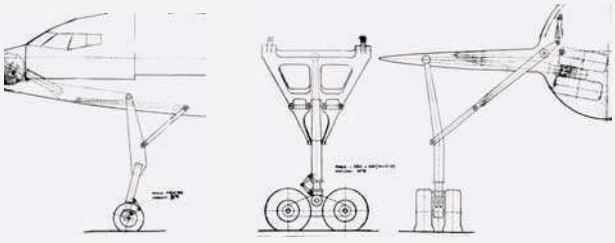
Presumably drawings #105, #107, #109 and #111 were allocated to the conventional turbojet-equipped version and drawing #108 relates to the nuclear version. These missing items are yet to be rediscovered. The brochure verifies that the nuclear-powered version fulfils requirements established by Sud (at that time there was still no governmental programme for an aircraft thus powered). The airliner's potential speed range was an early concern; it was feared that heat-exchange issues may prove problematic owing to kinetic heating, i.e. the heating of a solid body produced by its high-speed passage through air, whereby its kinetic energy is converted to heat by skin friction on the surface of the object. It was predicted that the aircraft's outer skin could become extremely hot at high speed. Sud verified that the heat-exchange process worked best between Mach 1·8 and Mach 2, thus fitting within the speed parameters targeted by the company in its Super-Caravelle programme.

THE SIZE

The question of the aircraft's range, which would later rear its head in the development of Concorde, is also discussed. Up until 1961–62 the French view was that the supersonic Super-Caravelle would be used on the same routes as the conventional Caravelle — medium-range European routes, linking capital cities. A nuclear-powered version would not fit this strategy, however, as the brochure explains: "The very notion of range is no longer significant; the range of such an aircraft [with nuclear propulsion] becomes practically unlimited. Operational constraints of such an aircraft are more important than for a conventionally powered aircraft, [and it is therefore] better suited to very-



***This original three-view from the nuclear-powered Super-Caravelle brochure shows some of the proposed version's salient features, including,* RIGHT*, the strengthened four-wheel bogie main undercarriage and the nuclear pile located aft of the stowed mainwheels,* BELOW.**



RIGHT ***Detail drawings showing, from furthest right, front and side views of the beefed-up mainwheel units with four wheels, and the twin nosewheel arrangement. All of them were designed to offer extra strength on the basis that, on a nuclear-powered variant with little conventional fuel aboard, landing weights would be much the same as those for take-off.***

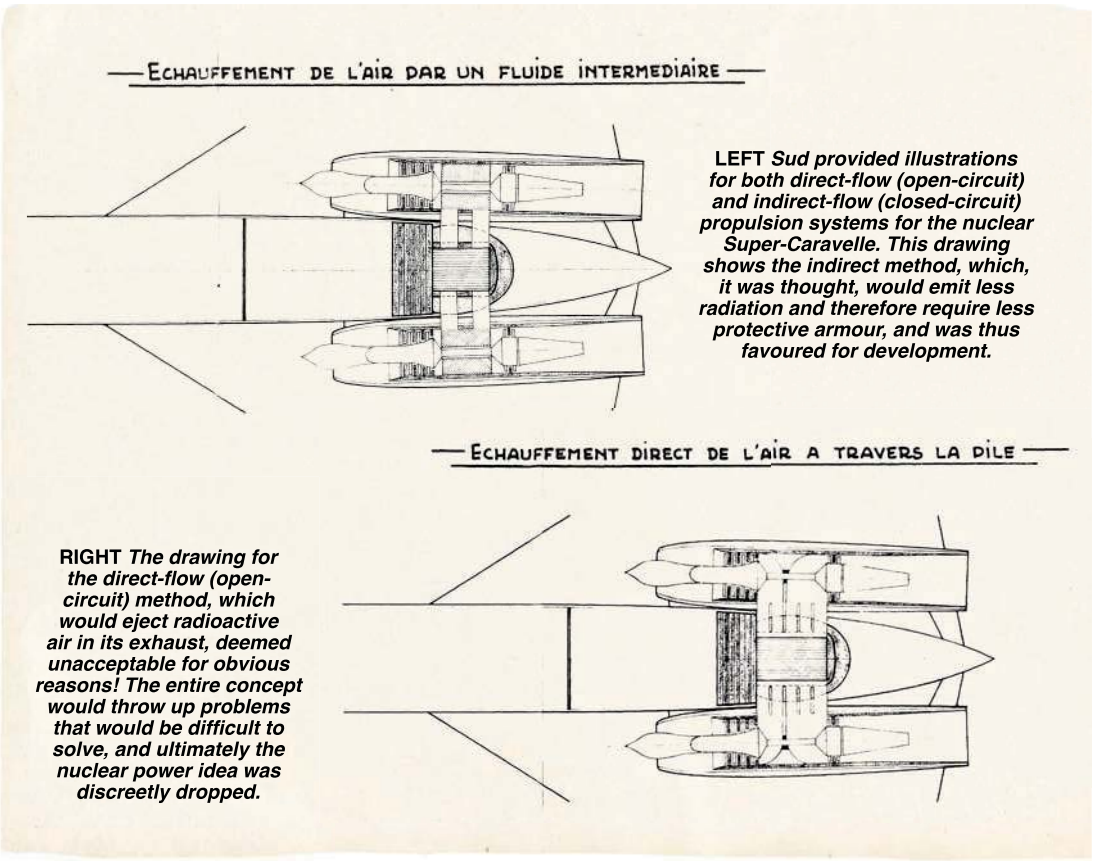
long-range routes. With the current state of our knowledge, the nuclear variant of the Super-Caravelle must be regarded as an extension to routes longer than the 3,000km (1,900 miles) of the conventional variant".

The payload could also be affected by the adoption of nuclear propulsion. The brochure states: "Because the fuel consumption is negligible, while the engine section of the aircraft is larger than in a conventional machine, it could be tempting to enlarge considerably the payload". The brochure evokes the possibilty of arranging multiple turbojets *en barillet* (literally "in a barrel" — i.e. in a cylindrical cluster around the rear fuselage) as per an earlier configuration designed in the late 1940s (which ultimately led to the Caravelle), but this was later rejected as being impractical for two reasons. First, the difficulty in designing the circuits which linked the reactor to the engines, limiting the number of these to one each side of the fuselage; and secondly, the desire to avoid the extra complexity of designing a much larger aircraft.

As a result the aircraft was only slightly enlarged; the fuselage diameter was increased to 3·8m (12ft 6in) and the payload to 15,000kg (33,000lb). Both fuselage and wings were increased in size but the wing structure was simplified, on the basis that the very low fuel consumption of the reactor would not require a lift:drag ratio as precise as that of a conventionally powered aircraft. The general layout was kept the same as the base Super-Caravelle project, but the passengers were relocated forward, away from the reactor and engine system at the rear. Also, the low fuel consumption eased the problem of weight balancing.

The undercarriage was reinforced, as it would have to cope with landings made at roughly the same weight as take-off, so four-wheel bogies replaced the twin wheels of the base design. The mainwheel bays were situated between the engine section and the passenger-section shielding. It was considered that this section, situated in a "dead space" between the two shielding panels, could be used, as long as it did not contain "life forms". In retrospect, this was probably somewhat optimistic, as seeping radiation may have had a negative effect on the lifetime of the rubber used in the tyres.

One aspect which the design office was keen to retain was the canard configuration of the base design, which would have proved favourable for adaptation to nuclear propulsion. Little did



LEFT *Sud provided illustrations for both direct-flow (open-circuit) and indirect-flow (closed-circuit) propulsion systems for the nuclear Super-Caravelle. This drawing shows the indirect method, which, it was thought, would emit less radiation and therefore require less protective armour, and was thus favoured for development.*

RIGHT *The drawing for the direct-flow (open-circuit) method, which would eject radioactive air in its exhaust, deemed unacceptable for obvious reasons! The entire concept would throw up problems that would be difficult to solve, and ultimately the nuclear power idea was discreetly dropped.*

they know, however, that the canard would ultimately prove to be a *cul de sac*; one out of which Sud took more than a year to find its way.

THE POWERPLANT

Initially, both open- and closed-circuit reactors were studied for the Super-Caravelle and appear in the drawings. However, after consultation with Snecma, it was concluded that the closed-circuit quick-neutrons atomic pile was the better solution. Not only did it avoid the production of "activated air" (for which read radioactive) behind the turbojets, it also kept the powerplant's weight down to 59,000kg (130,000lb), even accounting for the engine hardware, shielding partitions and heat-exchange liquid. The open-circuit thermal neutrons system weighed 100,000kg (220,000lb). Liquid bismuth (or more probably a lead/bismuth alloy) was selected as the best heat-transfer agent to transfer heat from the reactor to the turbojets.

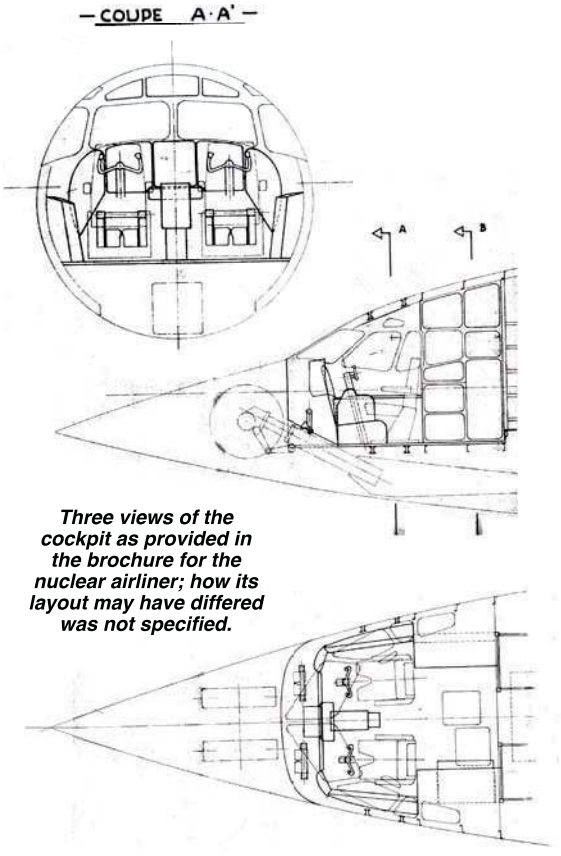
The brochure also recommends the "open cycle" solution to start the turbojet, by injecting kerosene into the front of the turbine, but no provision for a conventional fuel tank is mentioned in the design documents for this machine. Two nuclear-powered turbojets were deemed sufficient to power the aircraft, and these were to be attached to the rear of the fuselage, as pioneered on the Caravelle. This allowed the entire propulsive unit to be located as far as possible from the crew and passengers.

Two armoured shielding panels were to be installed; one around the reactor itself and a lighter panel just aft of the passenger cabin. The brochure declared that residual radiation would not bring any adverse health effects:

"It would take 130 flight hours for the most exposed passenger to receive a dose of radiation equivalent to a single radio [x-ray] examination . . . the shielding designed would allow a person to fly in this aircraft for 8hr each working day throughout his/her entire lifetime without any noticeable effects."

One of the more challenging aspects of using nuclear-powered engines would be controlling the thrust of the turbojets. The "thermal inertia" of the pile meant that controlling the turbojet's thrust could not be achieved by means of modulating the energy being provided by the reactor. The brochure therefore concludes that "thrust control would have to be obtained using jet deflection to allow for a quick reaction to pilot commands . . . control at altitude would need further specific research".

The brochure does not shy away from various concerns regarding the practical operation of



Three views of the cockpit as provided in the brochure for the nuclear airliner; how its layout may have differed was not specified.

NUCLEAR SUD SUPER-CARAVELLE DATA

Powerplant 2 x unspecified turbojet engines of 30,500kg (67,240lb)-thrust each

Dimensions		
Span	24·0m	(78ft 9in)*
Length	46·0m	(150ft 11in)
Wing area	270m²	(2,903ft²)
Passengers	120	
Weights		
All-up weight		
open-circuit system	136,690kg	(301,345lb)
closed-circuit system	118,190kg	(260,560lb)
Performance		
Maximum speed	Mach 1·8 at 11,000m (36,000ft)	
Range	3,500km+	(2,200 miles+)

*from measurement taken on a 1/100th-scale drawing

Nuclear propulsion system (Closed-circuit system with liquid bismuth as transfer fluid)		
Size of pile (reactor)	0·84m	(2ft 9in)
Size of armoured case around reactor	0·95m (3ft 1in) lithium hydride + 0·46m (1ft 6in) lead	
Weights		
Nuclear pile	3,000kg	(6,600lb)
Armour (including reactor case and armoured bulkheads)	46,000kg	(101,000lb)
Heat-exchange system incl liquid bismuth	10,000kg	(22,000lb)

the aircraft. First, there was the radioactive contamination of the airframe behind the armoured shielding bulkheads:

"We may hope the activation [radioactive contamination] of the materials which will result from the thinner side-armour will be low enough not to impair the rigidity [of the airframe], yet it may be enough to render access difficult and impose operational constraints. Notably we have been forced to position passenger access doors at the front of the aircraft."

This statement goes beyond the purely ergonomic aspects of the aircraft in terms of access, as Georges Héreil had requested an "*air de famille*" ("family likeness") between the supersonic Super-Caravelle and its subsonic forerunner — and a major feature of the latter was the incorporation of retractable stairs under the rear fuselage.

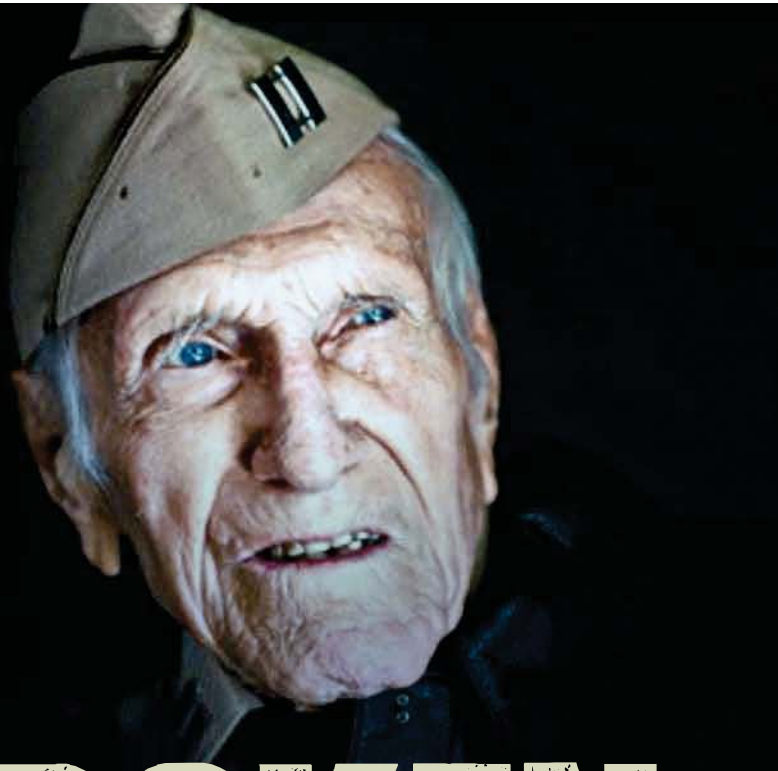
Stopping the engine also brought problems, as the nuclear reactor would remain hot for a long period after the turbojets had been shut down; the aircraft would have needed a powerful system to provide a rapid enough rate of cooling of the reactor. (It is now a well-established fact that stopping the reactor in a nuclear power station is an extremely complex operation.)

A consideration not mentioned in the brochure is the need to purge the lead/bismuth fluid before it cooled enough to choke the pipe network of the reactor. Work on the reactor itself also posed significant problems that the design team could not really solve. For example, the brochure notes that this issue could have an impact on the aircraft's "turnaround ratio" (i.e. the number of times it could fly a specific route during a day/week).

A further study, this time for a nuclear-powered vertical take-off and landing (VTOL) supersonic transport, was attempted using a closed-circuit quick-neutrons reactor, giving a take-off weight of 190,000kg (419,000lb) for the complete aircraft. This study was not pursued, however, owing to problems relating to the number, positioning and installation of the direct-lift jet engines.

THE CONCLUSION

The nuclear-powered Super-Caravelle is a testament to the technological optimism of the times, but even then one can all-too-easily perceive the inherent difficulty and enormous challenges of designing, building and operating such a wildly ambitious machine. Obviously, even to Servanty, this was in reality little more than an engineer's dream, and nothing more was heard about this particular *grand projet* after the brochure's publication.



The subject of numerous biographies, articles — and most notably Angelina Jolie's 2014 film *Unbroken* — former national sports hero and USAAF Pacific War veteran Louis Zamperini always maintained that the two B-24s that nearly cost him his life were named *Super Man* and *Green Hornet*; B-24 specialist **BOB LIVINGSTONE** digs deep into the archives to reveal that neither is in fact correct, and finally sets the record straight

UNBROKEN

THE MYTH OF LOUIS ZAMPERINI'S CONSOLIDATED B-24s

ALTHOUGH THE story of USAAF Bombardier 1st Lt Louis Zamperini has been told in at least eight books, several DVDs and innumerable magazine and newspaper articles and web pages — and not least in Angelina Jolie's Hollywood movie *Unbroken* — there is one constant: the names of the two Consolidated B-24s which featured most prominently in his life — those which almost took his life during two missions in the Pacific War.

Accepted lore has it that these two aircraft were named *Super Man* and *Green Hornet*. It must be so. Zamperini said so. Book after book says so. The movie of his life features these names. Without diminishing the legacy of Zamperini's life story, the historical record reveals that, while the incidents are true, the aircraft names Zamperini remembered are not.

There is no doubt that, as he was consulted and interviewed for the majority of these books, the names of the aircraft were provided by Zamperini himself, and that these were accepted by the authors in good faith. The names are certainly those of B-24s assigned to his squadron; furthermore, it is more than likely he flew in them at some time — but recent research points conclusively to the fact that neither matches the aircraft involved in the incidents for which they have become famous.

ALL PHOTOGRAPHS VIA AUTHOR

EARLY DAYS

Louis Silvie Zamperini's early life gave no intimation of his later celebrity; indeed, notoriety seemed more likely. Untameable as a small child, Louis grew into a brawler, house-breaker, petty thief, mischief-maker and general nuisance to his community as a pre-teen, never far from juvenile hall or jail. As author Laura Hillenbrand put it in her book *Unbroken* (Random House, 2010): "He shaped who he would be in manhood. Confident that he was clever, resourceful and bold enough to escape any predicament, he was almost incapable of discouragement. When history carried him into war, this resilient optimism would define him".

Louis turned his life around in high school on the athletics field, earning varsity letters in basketball and baseball. But it was on the track that he shone, setting the school mile-record at 5min 6sec. He ran and ran, finally running himself into selection for the 1936 Berlin Summer Olympics. His *forté* was the mile, the 1,500m being the Olympic equivalent; but circumstances caused him to run the 5,000m instead, in which he placed only eighth.

Setting his sights on the 1940 Summer Olympics, to be held in Tokyo, Louis trained exhaustively for the 1,500m, and by 1939 he was a household name in America. However, international events conspired against him with the outbreak of war in Europe. The 1940 Summer Olympics were cancelled in April that year and by September Congress had passed the draft bill.

In early 1941 Louis joined the US Army Air Corps (US Army Air Forces — USAAF — after June 20, 1941) for pilot training, but was "washed out". By September 1941 he had been sent for training as a bombardier, graduating as a 2nd Lt in August 1942. He was posted to dusty Ephrata, Washington, where the 372nd Bomb Squadron (BS) of the 307th Bomb Group (BG) was forming up and training. Zamperini joined a B-24 crew commanded by 2nd Lt Russell "Phil" Phillips. By mid-October their training had been cut short, however, and they were issued with a new B-24D and despatched to the Pacific staging post of Hamilton Field, California, where they prepared themselves and their aircraft to join the war.

During these preparations many aircraft were given names. Most crewmen referred to their aircraft as "she", but Phillips insisted that theirs

OPPOSITE PAGE, BOTTOM ***Consolidated B-24D serial 41-24253*** **Green Hornet** ***of the 372nd Bomb Squadron in early November 1942 at Kahuku, Hawaii. Zamperini maintained it was this aircraft in which he crashed while on a search mission in May 1943 — but was it?*** **ABOVE** ***Zamperini (left) with a two-mile relay race running mate in 1939.***

ABOVE LEFT ***An extremely rare photograph of the "Super Man" nose art of B-24D serial 41-23938, in which Louis Zamperini flew on the mission to Wake on the night of December 23–24, 1942.*** **ABOVE RIGHT** ***Although Zamperini recalled flying in*** **Super Man** ***on the Nauru mission of April 20, 1943, he actually flew it in*** **Take Off!,** ***serial 41-24149.***

was "all man", and a rather crudely painted Superman comic-strip figure appeared on the nose. This was B-24D-13-CO serial 41-23938, in which Phillips and his crew flew from Hamilton to Kahuku, Hawaii, on November 2, 1942, to join the US Seventh Air Force, and from where the crew flew training flights and sea patrols. During this time a number of the original crew members were transferred to other crews and replaced.

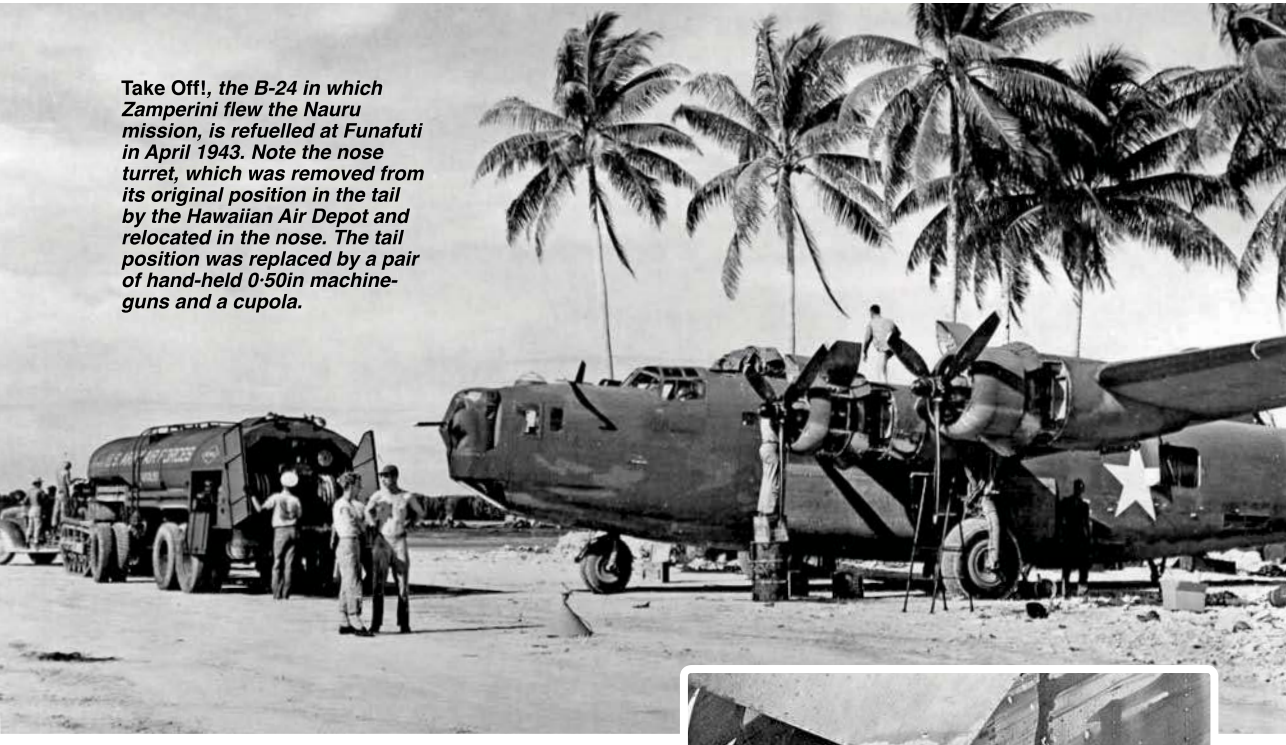
SUPER MAN INTO COMBAT

It was not until December 21, 1942, that Phillips and crew embarked on a bombing mission, flying *Super Man* alongside 25 other 307th BG B-24Ds to Midway as a refuelling and stopover point. Their target was to be Wake, then being occupied by the Japanese, as part of the first American attack on the atoll on the night of December 23–24, recorded as "The Christmas Eve Attack on Wake".

The mission had been made possible only by filling one of the B-24s' two bomb bays with an auxiliary fuel tank. The latter fitted to *Super Man* shifted when the aircraft's descent was arrested at 2,500ft (760m) to bomb, interfering with the bomb-bay doors, which would no longer close. This slowed the aircraft and increased its drag and fuel consumption, the engines shutting down as they landed back at Midway owing to lack of fuel. No aircraft were lost on the mission and only superficial damage was reported to a small number of B-24s. By the time the 307th BG returned to Hawaii each aircraft had flown more than 4,300 miles (6,900km), and the crews were back in time to celebrate the new year.

At this time B-24Ds were manufactured with a "glasshouse" nose incorporating a single 0·30in machine-gun pointing forward. This was one of the most vulnerable parts of the aircraft, and Japanese fighter pilots quickly altered their tactics to concentrate on head-on attacks against USAAF

BELOW ***The first B-24 to be fitted with a modification designed by the Hawaiian Air Depot to support a nose turret was B-24D serial 41-23657. It is seen here being refuelled on Midway for its ill-fated reconnaissance flight to Wake on December 28, 1942, to assess bomb damage following the 307th BG's raid on the atoll four days previously.***



Take Off!, *the B-24 in which Zamperini flew the Nauru mission, is refuelled at Funafuti in April 1943. Note the nose turret, which was removed from its original position in the tail by the Hawaiian Air Depot and relocated in the nose. The tail position was replaced by a pair of hand-held 0·50in machine-guns and a cupola.*

bombers; an accurate burst of cannon fire could kill everyone forward of the bomber's waist.

Entrepreneurial USAAF officers such as Marion Unruh, the 90th BG's Engineering Officer and later the 5th BG's Commanding Officer, were working with the Hawaiian Air Depot (HAD) to modify a B-24 tail gun turret and fit it into the nose. Their prototype, serial 41-23657 from the 370th BS, had been part of the outbound group on December 21 to Midway, and was sent from the latter on the 28th on a reconnaissance mission to Wake to assess the bombing damage. About 200 miles (300km) from Midway an emergency caused the B-24 to ditch; neither the aircraft nor any survivors were ever found.

The modification was a success, however, and a production line of used aircraft began in earnest at the HAD on March 29, 1943; all new B-24Ds passing through Hawaii on their way to Pacific BGs were subsequently fitted with a nose turret.

THE NAURU MISSION

The need to replace the shorter-ranged Boeing B-17 with the B-24 in the Pacific split the 307th BG in two. The 371st and 372nd BSs remained at Kahuku flying sea-search missions, while the 370th and 424th departed for Guadalcanal and the Thirteenth Air Force on February 11, 1943, replacing the 11th BG, which returned to Hawaii to re-equip with the B-24.

Zamperini's next major mission was to be a raid on the phosphate works on Nauru in the central Pacific. On April 17, 1943, 24 B-24s of the 371st and 372nd BSs staged through Canton Island and arrived at Funafuti Atoll in the Ellice Islands (now part of Tuvalu) the next day. They were to fly three specific missions devised by the

ABOVE ***Louis Zamperini inspects just one of the many holes in* Take Off! *after the Nauru raid, the result of anti-aircraft cannon fire. Other photographs taken at this time prove that it was* Take Off! *and not* Super Man *that Zamperini and his crewmates flew in for the April 20 raid on Nauru.* Super Man *was almost certainly still in Hawaii being fitted with its nose turret at this point.***

Seventh Air Force's commander, Gen Willis H. Hale. Funafuti is a typical "South Seas tropical paradise" of sand and palm trees and a crushed-coral runway, which now serves as the airport for Tuvalu. Accommodation was in tents, with grass huts in the native village for the more important administration services.

The aircraft selected for the Funafuti detachment were the total output of the HAD nose-turret modification line by this date, which meant that *Super Man* remained at Kualoa Point on Oahu in Hawaii. Among the more seasoned crews were a few "unblooded" crews who had ferried

ABOVE ***Covering only eight square miles (21km²), Nauru is rich in phosphate and was thus of interest to the Japanese, who occupied the tiny island on August 25, 1942. Here, Seventh Air Force B-24*** **Sad Sack** ***(serial unknown) flies over the burning phosphate works and airfield during the raid of April 20, on which Zamperini flew.***

new aircraft from the USA to Hawaii and gone on almost immediately to Canton and Funafuti, including one 371st BS crew captained by 2nd Lt Herbert Kurz, flying B-24D serial 42-40101, which the crew had named *The Green Hornet*. Only 22 of the 24 B-24s flew the first of Hale's special missions, to Nauru on April 20, two having returned with mechanical problems, including Kurz's *The Green Hornet*.

Zamperini's aircraft, identified by him as *Super Man*, was badly damaged by anti-aircraft fire on the bomb run, and was subsequently further damaged by cannon fire from attacking Zeroes. The aircraft crash-landed with a flat tyre on its return to Funafuti, with four wounded crew, one of whom later died. The ground crew counted 594 holes in the aircraft.

This is where we deviate from the popularly held story. Photographs of the aircraft at Funafuti showing the damage to the tail and fuselage, with Zamperini and copilot "Cup" Cuppernell examining a large hole in the bomb bay, clearly show the serial to be 41-24149 — an aircraft named *Take Off!*, not *Super Man*. *Take Off!* was subsequently repaired and transferred to the 11th BG's 42nd BS and survived until at least October 24, 1943, after which it disappears from the records. As it was unserviceable on this date, it was probably retired as "war weary".

Meanwhile, *Super Man* was fitted with a nose turret in Hawaii, remained in combat condition and was transferred to the 11th BG's 98th BS in June 1943, with which it was later renamed *Sexy Sue-IV Mother of Ten*. It was lost on the early morning of January 20, 1944, in the vicinity of Wotje Atoll in the Marshall Islands, with Lt Charles "Hoppy" Hopkins and crew aboard.

The Japanese clearly had excellent intelligence and knew exactly where the Nauru bombers had come from, because on the next night (April 21–22), 14 Japanese bombers attacked the airfield at Funafuti, destroying two B-24s (42-40072 and 42-40089, *Flying 8 Ball Jr*) and damaging five others; US Marine Corps unit VF-41 lost a Grumman F4F with another eight damaged.

TWO GREEN HORNETS

On April 23 the 371st and 372nd BSs flew a mission to Tarawa Atoll (now the capital of the Republic of Kiribati) from Funafuti, in which Kurz's *The Green Hornet* participated, despite having to fly with a scratch crew after four of the original crew had been killed or injured in the Japanese bombing raid. Zamperini did not fly this mission; the Phillips crew was granted a recovery day after the ordeal over Nauru. The wounded from the Nauru mission and those, including Marines, wounded during the Japanese attack had to wait

LEFT ***General Willis H. Hale (far left), commander of the Seventh Air Force, who masterminded the Funafuti missions in April 1943, points out the message scrawled on a 1,000lb (450kg) bomb — "From Nimitz to Hale to Tojo" — to some of the airmen he expects to deliver it. Hale's resources were limited, and the press back home labelled the Seventh "Hale's Handful".***

BELOW ***On the night of April 21–22 the Japanese retaliated for the attack on Nauru, a force of 14 bombers destroying two B-24s, including 42-40089, named*** **Flying 8 Ball Jr,** ***the wreckage of which is seen here the morning after.***

ABOVE ***The crew of B-24D 42-40073*** **Thumper** ***boards the "bus" to the tented accommodation outside the village soon after their arrival on Funafuti in April 1943. The Japanese had intended to occupy Funafuti as part of their defensive perimeter but losses at Midway in June 1942 delayed the plan and the Americans arrived in October.***

until the 23rd, when Consolidated LB-30 AL633, *Old Faithful*, from the Seventh Air Force's 19th Troop Carrier Squadron, aka Southern Cross Airways, flew in from Hickam Field, Hawaii, to transport them to hospital in Samoa.

The co-existence of the 371st BS's *The Green Hornet* (42-40101) and the 372nd BS's *Green Hornet* (41-24253) has caused further confusion over the years, Zamperini himself having signed copies of photographs of the wrong aircraft.

Because of the Japanese attack on the atoll, Hales's third special mission, which had been planned from Funafuti to Ocean Island (now Banaba) was cancelled, and the day following the Tarawa mission the two 307th BG squadrons returned to Hawaii via Canton Island, to prepare for further offensive operations. The Phillips crew received six replacements before being posted on May 24 to the 11th BG's 42nd BS at Kualoa Point, along with some of the 307th's older B-24s, including *Super Man* and both *Green Hornets*.

THE FATEFUL SEARCH MISSION

The Pacific Wing of the USAAF's Air Transport Command controlled the ferrying of aircraft from Hamilton Field in California all the way to Australia, the initial leg being to Hickam Field on Hawaii. The route from there depended on weather and the endurance of the aircraft type, but the typical route for a B-24 was Canton Island—Nandi (now Nadi, Fiji)—Plaine des Gaiacs (New Caledonia)—Brisbane or Townsville in Queensland. The crew of 2nd Lt Clarence C. Corpening, which had begun its flight to Australia from Hamilton, departed Hickam in B-24D serial 42-40519 on May 26, 1943, for Canton Island, to ferry the aircraft to Brisbane. There the crew would have received their assignment as replacements for the 380th BG's 530th BS in Darwin, Northern Territory. They never arrived at Canton Island.

The aircraft was believed to have gone down about 200 miles (300km) north of Palmyra Island. Aircraft from the 42nd BS were alerted for a search mission on May 27. The 42nd BS Mission Report for the 27th states: "Special (sea search missing B-24); two sorties; destination Palmyra: Ship #219, Lt Phillips, TO [take-off] 1830; Ship #983, Lt Deasy, TO 1830; distance 800nm [1,280km]".

Deasy's aircraft was serial 41-23983 *Daisy Mae*, previously with the 307th BG's 372nd BS. The aircraft the Phillips crew was assigned was forever

ABOVE *Some confusion has arisen about which aircraft Zamperini* (ABOVE RIGHT *in full flying kit) flew in for the ill-fated search mission of May 27, 1943. Was it* Green Hornet, *serial 41-24253* (LEFT, TOP seen before the fitting of the nose turret) *or* The Green Hornet, *serial 42-40101* (LEFT, BOTTOM)*? The Mission Report reveals it was neither.*

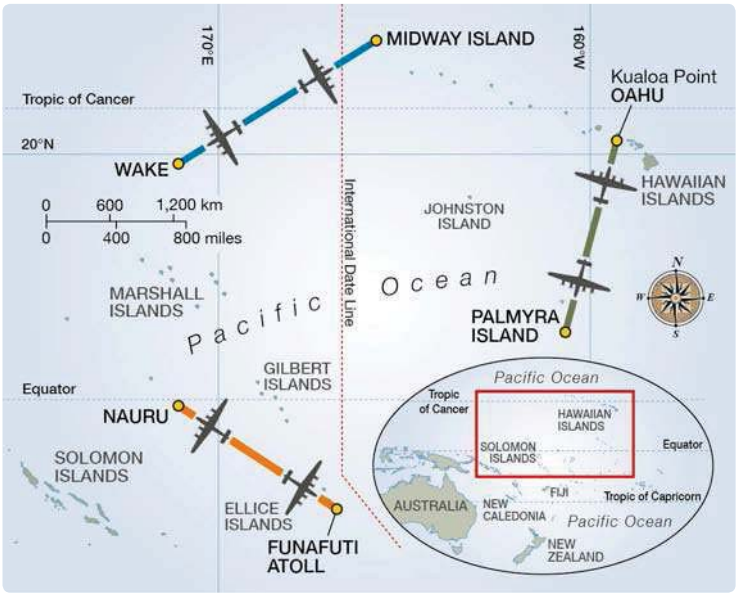
etched in Zamperini's mind as *Green Hornet* (41-24253). Zamperini claimed that the crew objected strongly to their assignment, complaining that the bomber was dangerous and barely airworthy. Eventually, however, Phillips reluctantly accepted it. The Mission Report — written after the loss of the aircraft — proves, however, that it was not *Green Hornet*. "Ship #219" was in fact B-24D serial 42-40219, known to have been named *Four Roses*. A new aircraft, it had been delivered to Hickam only on May 3, and had completed its nose-turret modification on the 10th. It had been with the squadron for approximately two weeks and no photographs are known to exist. Zamperini's own book, *Devil At My Heels* (Peter Davies Ltd, 1956), indicates that he noted in his diary that he was flying in his assigned aircraft, so the change must have been at short notice.

Green Hornet was B-24D-25-CO serial 41-24253, one of those rogue "Monday morning" aircraft which just never flew right, no matter what the engineers tried, and was often unserviceable. It flew tail-low, was a notorious "gas-leaker" and was the first aircraft to be stripped when a part was urgently needed to keep another aircraft in combat. It did not fly combat missions, as it was almost impossible to get into the air on take-off with a bomb load, so it was limited to the occasional search mission, employed mostly on the "cabbage run", becoming a "fat cat" for collecting fresh fruit, vegetables and meat.

On May 27 *Green Hornet* had just returned to the squadron after having completed the nose-turret modification, probably in the hope that the extra weight would move the aircraft's centre of gravity forward and improve its flight characteristics.

In *Unbroken*, Hillenbrand accepts Zamperini's version and, throughout the book, the aircraft in which he and his crewmates ditched is referred to as *Green Hornet*. It seems that time obliterated the change from Louis' mind, leaving only the deeper memory of how frightened they were at the prospect of having to fly 800 miles (1,300km) over water in a notoriously worn-out aircraft.

Confirmation that Zamperini's aircraft on the May 27 mission could not have been *Green Hornet* comes from the USAAF record card for the aircraft, which states that 41-24253 was returned to the USA and converted to a CB-24 (approximate C-87 transport standard) by United Air Lines. The latter must have sorted out most of its foibles as it was used by the airline on its Pacific transport



LOUIS ZAMPERINI'S COMBAT MISSIONS

Louis Zamperini and his crewmates arrived in Hawaii on November 2, 1942, and soon began undertaking training flights and sea patrols. The map at left shows the three most significant of Zamperini's combat missions; key to mission colours below. Map by MAGGIE NELSON

December 21, 1942; B-24* Super Man*; Midway—Wake—Midway

April 20, 1943; B-24* Take Off!*; Funafuti—Nauru—Funafuti

May 27, 1943; B-24* Four Roses*; Oahu—Palmyra Island (crash)

routes until it was salvaged in January 1945. Interestingly, *The Green Hornet* (42-40101) was also retired from combat, to become a transport for the 494th BG and renamed *Ruptured Duck*, the salvage of which is recorded in December 1945.

In July 1943 the USAAF developed a requirement for a report to be raised for any crew member of an aircraft who was missing/unreported after 24hr had elapsed since the last known information on them. These Missing Air Crew Reports (MACRs) went to USAAF HQ in the USA, where they were issued a number in sequential order of receipt. Generally, individuals reported as missing before this date do not have a MACR raised for them, but on April 10, 1946, the USAAF raised MACR #16375 (later altered to #16163) for the loss of the Phillips crew. All crew are listed and the date and unit are correct — but the aircraft is misidentified as a B-17 and no serial is quoted. The last words on the MACR are as follows: "The fact that Louis S. Zamperini survived imprisonment is already a matter of press record", leading me to suspect that this MACR was raised owing to multiple enquiries to the USAAF for information which was not initially available. The MACRs became readily available to researchers when they were digitised and uploaded to the internet, but the lack of a serial number meant that Louis' statements were not able to be checked, and researchers came to a dead end for many years.

LOST AT SEA

The Phillips crew took off from Kualoa Point directly after Lt Deasy and crew had departed in *Daisy Mae*, both heading for separate search areas near Palmyra Island, where it was intended that they would land and refuel for the return flight. In the search area allocated to *Four Roses*, cloud was building and the aircraft was down to 800ft (250m) for Phillips to maintain visual contact with the water. Engines Nos 1 and 2 were using more fuel than those on the starboard wing and the fuel tanks were becoming unbalanced, affecting the flying characteristics of the aircraft. Transferring fuel to balance the tanks had just begun when No 1 began to shake badly; its revs fell dramatically, before the engine stopped altogether.

The aircraft immediately rolled to port and descended towards the ocean, the pilots struggling with the controls, trying to regain level flight. Too busy to feather the propeller, they called the engineer forward and in the confusion he feathered No 2 instead. Now both engines on the port side were dead, No 1 was windmilling, they were too low and in a deadly spiral which ended only when they smashed into the water.

Louis, in his crash position in the waist area, was amazed to find himself alive, but trapped by something wrapped around him as the shattered fuselage began its death-dive to the Pacific seabed 1,650ft (500m) below. He was wedged beneath a waist-gun mounting, the snapped control wires pinning him in place. He struggled furiously, then floated free. He felt the frame of the waist window, pulled himself through and inflated his Mae West, which dragged him to the surface. He gasped air at last, coughing up the saltwater and fuel clogging his lungs and stomach. Zamperini, Phillips (who had been thrown through the canopy) and Sgt Francis "Mac" McNamara (tail gunner) were the only survivors as they began the hell of 47 days adrift on the vast Pacific.

The 42nd BS Mission Report coldly states:

"Results: Lt Phillips with airplane and crew reported missing (by Bomber Command) at approximately 0430. Lt Deasy reached Palmyra. No further reports received on mission this date."

ABOVE ***Serial 41-23893,*** **Daisy Mae,** ***also participated in the search mission of May 27, but — unlike*** **Four Roses** ***— it managed to return. It is seen here damaged at Midway after a raid on Wake on July 22, 1943.***

RIGHT ***Zamperini (right) and fellow prisoner of war Fred Garrett, who had his leg amputated while a Japanese prisoner, after landing back at Hamilton Field, California, in October 1945.***

In the USA the telegram was received by the family on June 4. On the 5th, Louis' disappearance created headlines in the press and was the lead story on radio. On Samoa, the injured men of the crew from the Nauru mission heard the news while still in hospital. At Kualoa search missions were flown without results and were terminated.

The three men's 47 days in the raft far exceeded the 24 days Capt Eddie Rickenbacker spent adrift in a raft in October 1942 after his B-17 ditched on the way to Canton Island, considered at the time to be the limit of human survival in Pacific conditions. Louis and his companions suffered horribly; there was little food and water, the latter topped up by the occasional rain shower, as well as insufferable heat, cold, extreme sunburn and the mental anguish of seeing passing aircraft which did not see them. Added to this were circling sharks, a strafing attack by a Japanese bomber, and a typhoon. On the 33rd day adrift, Mac died, leaving just Phil and Louis after they slipped him over the side.

FROM FRYING PAN TO FIRE

On their last day in the raft they had drifted close to the Marshall Islands, where they were spotted by a Japanese destroyer, on which they were taken aboard. A rendezvous with a freighter saw the pair transferred and delivered to Kwajalein Atoll. Each had lost about half their body weight.

They spent the following two years as "guests" of the Japanese, treated in ways that it is not necessary to describe; they are well known. Louis, harking back to those pre-teenage years, had the worst of it; he would not be bowed and the guards, one in particular, treated him savagely.

In June 1944, following USAAF procedure, Louis' status was changed from "missing" to "deceased". This information reached Japan in November and the Japanese asked Louis to make it known that he was alive by appearing on the monthly Radio Tokyo show *The Postman Calls*. He wrote a piece that the Japanese accepted and he taped it for broadcast on November 20, 1944, bringing the news for which the family had dared not hope during the past 20 months.

An interesting sidelight is that after Kwajalein was invaded and taken from the Japanese by a combined force of US Army and Marines in early February 1944, Deasy, now Commanding Officer of the 42nd BS, was called to the island and shown translated Japanese documents. From their contents he was able to work out that three men had survived the crash of *Four Roses*, that one had died later and that the survivors were almost certainly Phillips and Zamperini. Although the USAAF now knew some of the story, nothing was known of them since their capture, and the news was not released.

Zamperini and Phillips endured the Japanese camp for a further eight-and-a-half months, both surviving their imprisonment, and both, though not together, were returned to the USA in mid-

THE ROLL CALL

Consolidated B-24D serial 42-40219, ***Four Roses***

Pilot 1st Lt Russell A. Phillips
Copilot 1st Lt Charles H. Cuppernell
Navigator 1st Lt Robert H. Mitchell
Bombardier 1st Lt Louis S. Zamperini
Engineer Corporal Michael J. Walsh
Assistant Engineer Staff Sgt Jay S. Hansen
Radio Operator Staff Sgt Frank Glassman
Assistant Radio Operator Private Leslie A. Deane
Armorer/Gunner Sgt Otto Anderson
Gunner Sgt Francis P. McNamara

UNIVERSAL STUDIOS

ABOVE ***In late 2013 filming began on*** **Unbroken,** ***a biographical film of Louis Zamperini's life directed by Angelina Jolie (left) and co-written by Joel and Ethan Coen, in which British actor Jack O'Connell gave an award-winning performance as Zamperini (right). Another film,*** **Unbroken: Path to Redemption,** ***was made about Zamperini in 2018.***

October 1945. Louis' tormented body meant that he would never run again. He married, but the years of mental and physical torture caused him to turn to alcohol, and he seemed bound for an early death. In late 1949, however, he met the Christian evangelist Billy Graham and he turned his life around for the second time.

EPILOGUE

Towards the end of Louis' life, American actor Angelina Jolie was looking for a third movie to direct after *A Place in Time* and *In the Land of Blood and Honey*. She read Laura Hillenbrand's book and decided that this was the vehicle she wanted and she befriended Louis. Universal Studios, which had owned the rights to *Devil At My Heels* since 1956, had made a number of failed attempts to get the story off the ground, but Jolie pitched her take on it to Universal for her to direct, won approval and "broke the jinx" that had dogged this project for more than 50 years.

Filming of the project, given the title *Unbroken*, was completed in February 2014 and the finished article was released in November the same year. The movie was filmed in Australia, and I was the B-24 consultant, spending three weeks on the set in January 2014 while the flying sequences were being filmed.

So why were these corrections regarding the airframes' identities not made? After years of watching the aviation rubbish in some movies and TV shows and wondering about the credentials of the credited advisers, I now have some sympathy for them. By the time I arrived the scripts were all written; I had no control over the daily rushes and pride of place on the set was a full-scale B-24 fuselage with *Super Man* artwork emblazoned on the nose. I quickly appreciated that some things are just too expensive in time and money to change; and so, to avoid giving the director one more thing to worry about, I kept my counsel.

Nevertheless, on day one of shooting, within minutes of meeting Angelina Jolie (who has a twin-engined instrument pilot rating herself), I did point out to her that two scripted scenes detailing the bombing of Nauru were not as it would have happened in 1943. She accepted my advice, joined the two scenes into one and it became more realistic. Subsequently there were times when I "tweaked" the script and corrected other things, taught the cast how to fly an aircraft and told them some back-story, so I was able to make my mark on the movie. Unfortunately, Louis Zamperini died, aged 97, on July 2, 2014, four months before the film's release — but he had at least seen a rough cut of the movie.

Garuda's 'Hamble Boys'

When Indonesia gained its independence from The Netherlands in December 1949, it initially had to continue relying on Dutch national airline KLM to provide personnel and infrastructure for its own newly minted national airline, Garuda Indonesian Airways. **SUDIRO SUMBODO** explains how the nation's first homegrown generation of commercial pilots came to learn their trade at "Britain's Air University"

DURING THE 1950s the newly independent state of Indonesia sent its civilian pilot students abroad, notably to "Britain's Air University" run by Air Service Training Ltd (AST) at Hamble, Hampshire, on England's South Coast. When the Republic of Indonesia had gained independence from The Netherlands back in December 1949, the nation had no commercially qualified pilots of its own, and a plan had to be put in place to train the country's first batch of civilian pilots.

Starting from scratch

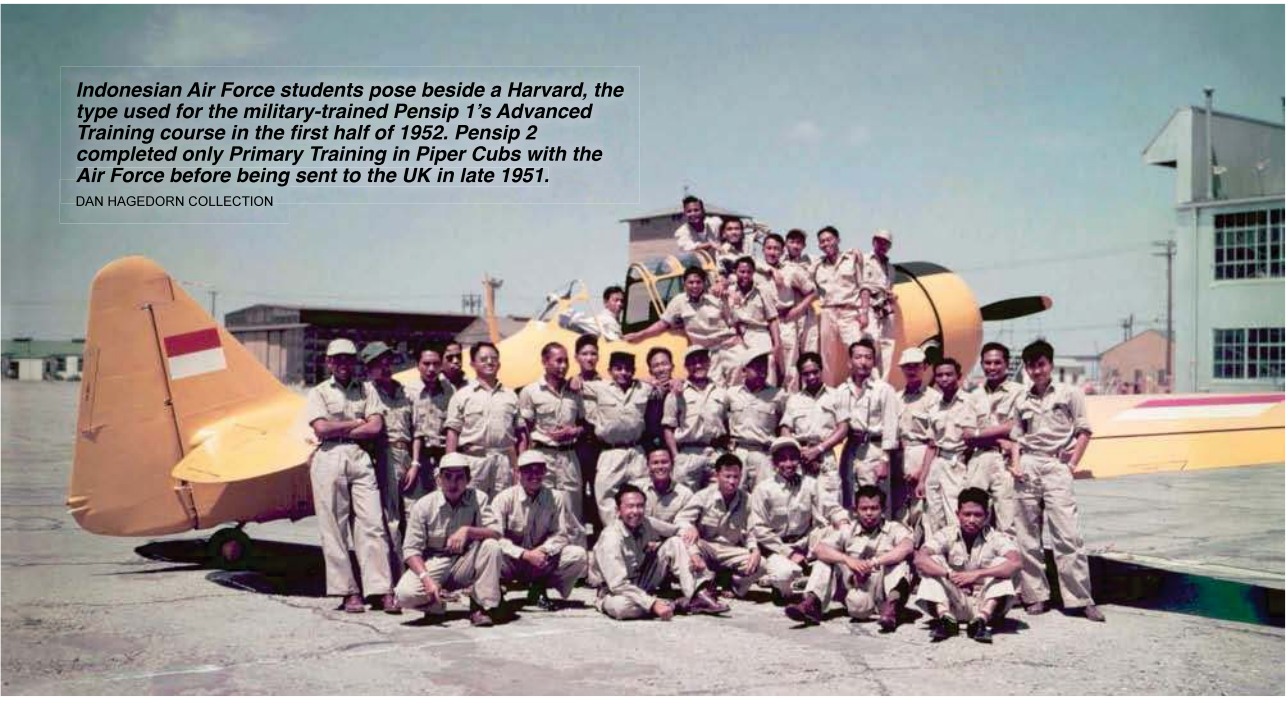
The new nation's flag-carrier airline, Garuda Indonesian Airways (GIA), was officially established on March 31, 1950, and was formed as a joint venture between the Indonesian government and Dutch airline KLM. On its establishment, Garuda had a good number of aircraft on strength, having inherited 22 Douglas DC-3s and a handful of Consolidated PBY Catalina amphibians from *KLM Interinsulair Bedrijf* (KLM-IIB), a KLM subsidiary formed in August 1947 following the dissolution of KNILM (Royal Dutch Indies Airways). With no pilots of its own, however, Garuda was forced to rely on *Assistant Groep KLM* for its aircrew.

In February 1951 the Indonesian Ministry of Transportation launched a newspaper and radio advertising campaign, inviting Indonesian youths aged 18-25 to apply for civilian pilot training. Of the hundreds of applicants, only 16 were accepted (including two from Burma), this induction being referred to as *Pensip/Penerbang Sipil 1* (Pensip 1 — Civil Pilot Course No 1).

Chief of the Air Staff (CAS) Air Marshal Suryadi Suryadarma proposed that the first course be conducted by the *Angkatan Udara Republik Indonesia* (AURI — Indonesian Air Force), giving the Ministry of Transportation time to establish a civilian training organisation

OPPOSITE PAGE, TOP ***Indonesia's "Hamble Group" pose in front of one of Air Service Training's Douglas Dakotas at Hamble in 1952.***
VIA AUTHOR

MAIN PICTURE ***Two of AST's three Dakotas — G-AMSV, 'MSW and 'MSX — await another training sortie at Hamble. All three arrived at AST in the spring of 1952 and served until late 1954, when they moved on to new owners.***
TAH ARCHIVE



Indonesian Air Force students pose beside a Harvard, the type used for the military-trained Pensip 1's Advanced Training course in the first half of 1952. Pensip 2 completed only Primary Training in Piper Cubs with the Air Force before being sent to the UK in late 1951.
DAN HAGEDORN COLLECTION

to fulfil GIA's personnel requirements.

The CAS's proposal was approved, and eventually Pensip 1 joined the *SPL/Sekolah Penerbang Lanjutan-1* (Continuation Pilot School No 1) at Andir (now Husein Sastranegara International Airport) at Bandung on West Java, on April 1, 1951. Despite being candidates for civilian pilot training, the students were essentially air force cadets, with the rank of Private, and had to obey military discipline and rules and live in barracks. The Primary Training course included groundschool, Link Trainer simulator sessions and dual instruction in a Piper J-3 Cub.

In August 1951, after each student had accrued about 25hr of dual and 30hr of solo flying, Pensip 1 graduated from the primary stage to become Corporals. Next came the Basic Training course, in which the students graduated to the Vultee BT-13 Valiant, each being required to accrue at least 40hr dual and 35hr solo flying. Graduating from Basic Training in December 1951, and acquiring the rank of Sergeant-Major, the students then commenced the last stage, Advanced Training, using North American T-6G/AT-16 Harvards, in which they had to record 35hr dual and 15hr solo flying, starting in early January 1952 and continuing until the end of May that year.

Although the military training was tough compared to standard civilian training elsewhere, the students of Pensip 1 got the chance to practise the arts of aerial dogfighting and ground-attack gunnery, a rare opportunity for civilian students anywhere. Finally, on June 1, 1952, the students received their Wings from Air Marshal Suryadarma and were promoted 2nd Lieutenants.

The civilian *Akademi Penerbangan Indonesia* (API — Flight Academy of Indonesia) was not established until 1952, which meant that the commercial conversion training of Garuda pilots would have to be completed overseas until such time as the API was fully ready.

Britain's Air University

The choice fell to AST in the UK, based on recommendations from KLM and the organisation's global reputation as "Britain's Air University". In addition, the role of AST for conversion training was included as part of Indonesia's contract to purchase 14 de Havilland DH.114 Heron 1Bs for Garuda — to become the largest fleet of the type in service anywhere.

Accordingly, the Indonesian Ministry of Transportation reopened the application process for the recruitment of the second batch of civilian pilot training candidates — Pensip 2 — in September 1951. This time 27 candidates were accepted, and, as with the first course, Pensip 2 was sent to Andir for Primary Training with the AURI. Unlike Pensip 1, however, the students enjoyed rather more comfort, being billeted at the art nouveau Villa Sonnevanck at Ciumbuleuit, Bandung.

A total of 18 Pensip 2 students graduated the Primary Training course at Andir, and made ready to be sent to England. The Pensip 2 students departed Tanjung Priok Port in Jakarta aboard the ocean liner *MS Willem Ruys* (later to gain fame as the *MS Achille Lauro*) in December 1951 for passage to Southampton. During the voyage, the students undertook lessons in English language and British customs (including table manners!). The group arrived at Hamble on January 9, 1952, and were greeted by the

LEFT ***Auster J/5F Aiglet Trainer G-AMUI is prepared for a training flight outside the distinctive hangar at Hamble. The Indonesian Pensip 2 students gained their instrument ratings for their CPLs on Aiglet Trainers at AST in mid-1952, before graduating on to the de Havilland Canada DHC-1 Chipmunk.***

TAH ARCHIVE

BELOW ***The Indonesian Hamble Boys pose for a photograph during a visit to Dunlop, along with AST a part of the Hawker Siddeley Group, at Coventry in 1954. By the summer of 1953 Indonesia's own flight academy, API, had been fully established and was equipped with Aiglet Trainers and Chipmunks.***

Mayoress of Southampton, Minnie Cutler, and Ganis Harsono from the Indonesian Embassy.

Groundschool activities at Hamble started on February 1, 1952, but flight training did not proceed as planned owing to winter weather issues. Flight training finally commenced in early March, the students using de Havilland Tiger Moths to accrue 40hr of flying to acquire their Private Pilot Licences (PPLs), although a number of students were "washed out" at this early stage. Graduating students continued their training in Auster Aiglet Trainers for their instrument ratings, a prerequisite for obtaining their Commercial Pilot Licences (CPLs), the examination for which was held at the end of October 1952. The course then graduated to the de Havilland Canada DHC-1 Chipmunk for night-flying training, culminating in a successful solo night flight, completed by the Indonesian students in late January 1953.

In the meantime, on July 15, 1952, the Indonesian students who had completed the Pensip 1 course with the AURI the previous month had arrived in England and joined the students of Pensip 2 to form what was known to the Indonesians as the Hamble Group. The Pensip 1 students did not need to undergo Primary Training at Hamble, but instead undertook a familiarisation course in order to proceed straight to the Advanced Training stage, in which they would convert to twin-engined types — Airspeed Oxford and Avro Anson — in early August 1952, the Pensip 2 group graduating to the twins at the beginning of March 1953.

In late September 1953 the Hamble Group began its training for the Senior Commercial Pilot's Licence (SCPL), using an illustrious and much-coveted type — the Douglas DC-3/C-47 Dakota. Although still students, the Indonesians

VIA AUTHOR

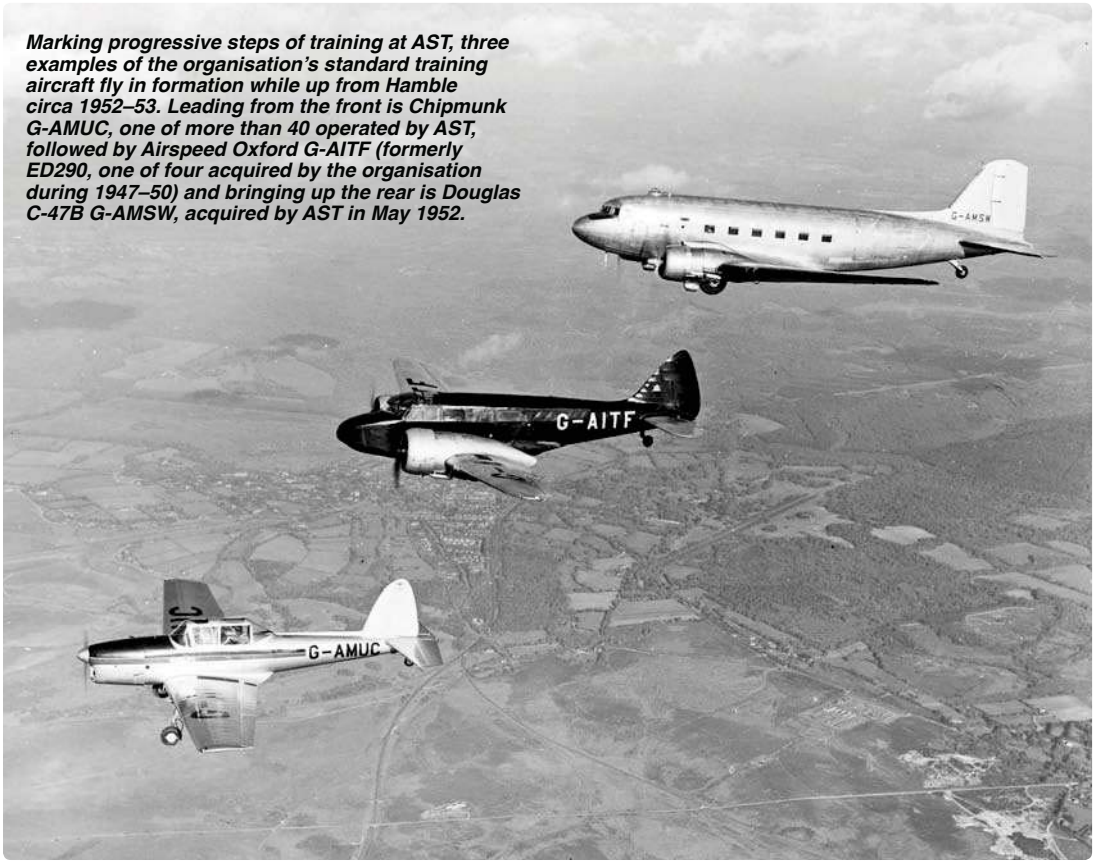
TAH ARCHIVE x 2

ABOVE ***Training on all aspects of aviation was covered at AST, technical classes sharing the syllabus with what was referred to at the time as "instilling both a knowledge of English and an understanding of Western ideology and customs . . ."***

RIGHT ***Students were sent to "Britain's Air University" from numerous points on the globe, leading to plenty of opportunity for the exchange of ideas and the promotion of discussion, especially during leisure time.***

BELOW ***The 18 students of Pensip 2 pose outside the front door of the AST main building. Seated in the front row at centre is Wg Cdr A.H. Abbott AFC, chief instructor responsible for the overall operation of AST at Hamble.***

M. SYAFEI VIA AUTHOR



TAH ARCHIVE

Marking progressive steps of training at AST, three examples of the organisation's standard training aircraft fly in formation while up from Hamble circa 1952–53. Leading from the front is Chipmunk G-AMUC, one of more than 40 operated by AST, followed by Airspeed Oxford G-AITF (formerly ED290, one of four acquired by the organisation during 1947–50) and bringing up the rear is Douglas C-47B G-AMSW, acquired by AST in May 1952.

could now readily imagine themselves as proper airline pilots. The SCPL examination was held on December 19, 1954.

While studying in England the Hamble Group gained much experience, some providing great amusement, including one student getting lost and landing at the wrong airfield during a cross-country navigation exercise in a Tiger Moth, and another forgetting to put his seatbelt on and hitting his head on the canopy of his Chipmunk during aerobatic practice.

Hamble 1 and 2

In late 1953 officials from the Indonesian Ministry of Transportation and Civil Aviation Department visited AST, requesting that the Hamble Group return home after having qualified to SCPL level, in order to start filling crews for the newly purchased Heron fleet, an SCPL being more than sufficient qualification to fly the type. However, according to the contracts signed by the members of the Hamble Group, they were to be trained to Airline Transport Pilot's Licence (ATPL) standard, not just SCPL, and the Group negotiated to complete the training as stipulated. It was finally agreed that students who achieved perfect results in the SCPL exam would be allowed to continue their training to ATPL standard; students with less than perfect SCPL exam results, and who would have to repeat even one subject, would have to return to Indonesia.

Accordingly, 11 Indonesian SCPL-qualified students (with a total of 350 flying hours) returned home on March 5, 1954, this group being designated Hamble 1. The group comprised students Sutarso, Sukarno, Sukamto, Suroso, Nurasid, Ojan, Hartono, Nurud Achmad, Sachroni, Nasution and Sadewo. The remaining 13 students acquired their ATPLs (with 380 flight hours) on June 1, 1954, and were designated Hamble 2, comprising Sumedi Amir, Roekanto Djokomono, M. Syafei, J. Repon, Soetjipto, Roebiono, Kusdjinatin, Abdul Rohim, Soejono, Lautan Siregar, Samadikun, Haripurnomo and Bambang Windukentjono.

The members of Hamble 1 were initially trained as copilots for the Heron, which served with Garuda from October 1953 until May 1960. Members of Hamble 1 were also posted to the Dakota fleet as copilots in early June 1955. From the outset the members of Hamble 2 were assigned to be Dakota copilots. Before being officially assigned as GIA copilots, however, they had to pass flight tests conducted by the API's chief instructor, a representative of the Civil Aviation Department. Unfortunately pilots Samadikun, Haripurnomo and Windukentjono

M.SYAFEI VIA AUTHOR

LEFT ***Hamble 2 alumni Sumedi Amir (second from right) and M. Syafei (furthest right) are awarded their Captain's epaulettes by Garuda's Managing Director Air Marshal Iskandar in Indonesia in 1957. The first of Indonesia's commercial pilots to be awarded full Captain status after completing an entirely civil training programme, the pair went on to become part of the group Garuda later referred to as "White-Hair Captains".***

BELOW ***By 1957 Garuda's Hamble Boys were becoming Hamble Men, gaining full captaincy on Garuda's fleet of Dakotas and Convairliners. Seen here at Hong Kong's Kai Tak airport in May 1957 is C-47A PK-GDW, one of the 22 acquired from KNILM in December 1949. It later served with Garuda subsidiary Merpati Nusantara.***

failed the latter test, and as a result became GIA Link Trainer/ground instructors.

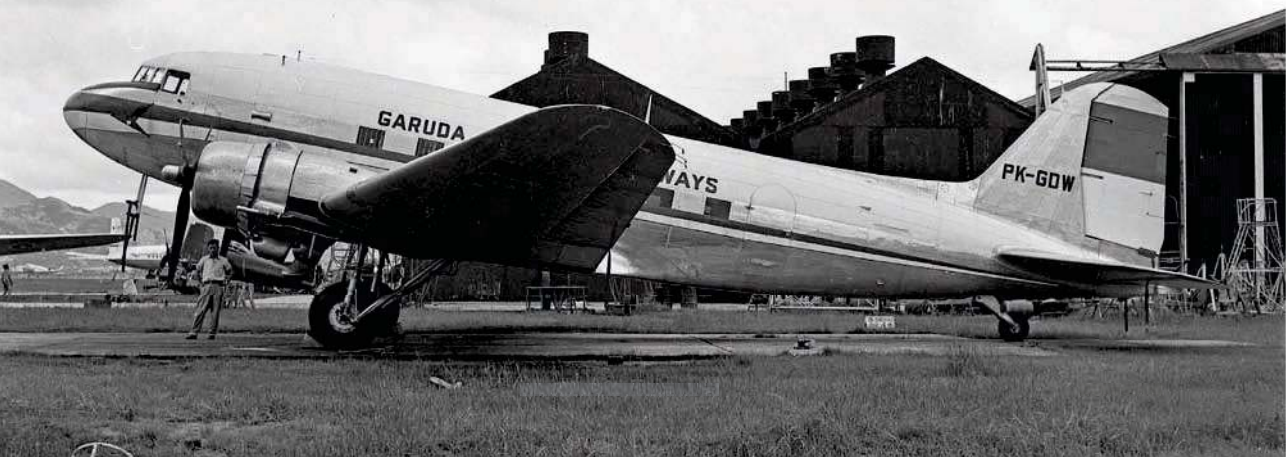
As well as the AST groups, GIA also acquired pilots released from the AURI and graduates from the *Rijksluchtvaartschool* at Ypenburg in The Netherlands. The "Hamble Boys" flew as copilots in Garuda's Heron, Dakota and Convairliner fleets, and would become "Hamble Men" during GIA's nationalisation process in 1957–58. This was a tough period as the airline was short of aircrew owing to the departure of Assistant Groep KLM pilots. The Indonesian pilots were also mobilised as part of Wing Garuda during Operation *Trikora,* an Indonesian military operation aimed at seizing the Dutch overseas territory of Netherlands New Guinea during 1961-62, and against the UK during Operation *Dwikora* a few years later (see *The Convair 990 and Garuda*, *TAH23*).

The 'White-Hair Captains'

With the delivery of a new generation of airliners to GIA in the early 1960s — Lockheed Electra turboprop in 1960; Convair 990A jetliner in 1963 and Douglas DC-8 (leased from KLM from 1966) — members of the Hamble Group were awarded the left-hand seat, serving international routes to Asia and Europe. By this time most of them had achieved full captain status, while others had occupied strategic positions in GIA as chief instructors, chief pilots, check pilots and, in one case, Vice-President of Ground Operations.

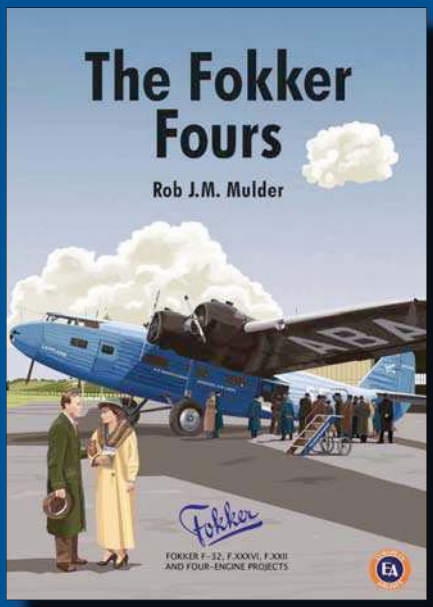
Some of Indonesia's AST graduates not only served with Garuda, but after leaving the airline also helped to establish private and charter airlines such as Bouraq Airlines and Mandala Airlines in the 1970s. Indonesia's flag-carrier changed its name to Garuda Indonesia in 1984, with the airline's new management approaching some of the AST graduates to fly its overseas routes. Dubbed "White-Hair Captains" by Garuda's Managing Director, R.A.J. Lumenta, these veteran civilian pilots flew Douglas DC-10 and Boeing 747-200 wide-body airliners until their full retirement in the mid-1990s.

ACKNOWLEDGMENTS *The author would like to thank "Hamble Boys" the late Capt M. Syafei, the late Capt Roekanto and Capt Sutarso for their invaluable assistance with the preparation of this feature*



The Fokker Fours

The History of the Fokker F-32, F.XXXVI, F.XXII and other four-engine projects



In September 1929, Anthony Fokker presented his first four-engine aircraft in the United States of America: the Fokker F-32. It could carry up to 32 passengers and was at its time the largest and most luxurious aircraft in the world. Then, unexpectedly, came the Black Thursday at the New York stock exchange and the world changed… Fifteen aircraft were either completed or in various stages of assembly, before the production was stopped.

The idea of a four-engine aircraft caught on with KLM Royal Dutch Airlines. Albert Plesman, its managing director, committed to buy aircraft for the Amsterdam-Batavia service. The Fokker F. XXXVI and its scaled-down version, the F XXII, were no immediate success due to the introduction of the far more modern and faster Douglas DC-2. The only other customer for the F.XXII was the Swedish airline AB Aerotransport and later Scottish Aviation and Scottish Airlines.

In this book we follow the life of the F-32, F.XXXVI and F.XXII aircraft and look at other Fokker four-engine projects. It is illustrated with many photographs, tables, and colour profiles by Juanita Franzi.

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THE ONE THAT GOT AWAY

How the Hawker P.1127 escaped Healey's axe

Continuing his regular series on various aspects of Britain's post-war aerospace industry, **Prof KEITH HAYWARD FRAeS** uses contemporary official sources to explore the political backdrop to the procurement of Hawker Siddeley's P.1127 — the extraordinary "jump jet" that was very nearly cancelled before it could be developed into the world-beating Harrier

BETWEEN OCTOBER 1964 and April 1965 the newly elected Labour government cancelled a swathe of British military aircraft programmes. Hawker Siddeley's state-of-the-art vertical/short take-off and landing (V/STOL) P.1154 fighter and HS.681 transport (also a prospective V/STOL aircraft) went first, followed by the British Aircraft Corporation's TSR.2 strike aircraft. This wholesale axe-wielding hit industry badly, and was only partly compensated for by confirmation of an Anglo-French military aircraft package. As both of the collaborative fixed-wing programmes (AFVG and Jaguar) went to the British Aircraft Corporation (BAC), Hawker Siddeley Aviation (HSA) stood to lose the most in future military work.[1] In time, however, orders for HSA's P.1127 V/STOL fighter would sustain its fighter design and production capabilities.[2]

What is less well known, however, is just how close the now iconic Harrier — as the P.1127 evolved into — came to inclusion in Labour's aerospace massacre. Without the Harrier, an important link with the USA may never have been made and the Falklands may perhaps have been lost to Argentina (no "counting them all out and counting them all back"). Arguably, if HSA's Kingston factory had closed, the Hawk jet trainer may also have failed to emerge in the 1970s.

ORIGINS

By the late 1950s Kingston (then still part of Hawker Aircraft Ltd, before the formation of HSA in 1963) was looking for a new product to supplement overseas sales of the company's Hunter, and efforts began to be focused on a radical V/STOL vectored-thrust concept.[3] Despite a lack of initial official interest, Hawker

nevertheless funded development of the concept until the government eventually awarded a contract, to Specification ER.204D, in June 1960, for two prototypes, allotted serials XP831 and XP836. Following the first untethered flight of XP831 on November 19, 1960, the government issued a contract for a "Development Batch" of four more P.1127 prototypes, serialled XP972, XP976, XP980 and XP984.

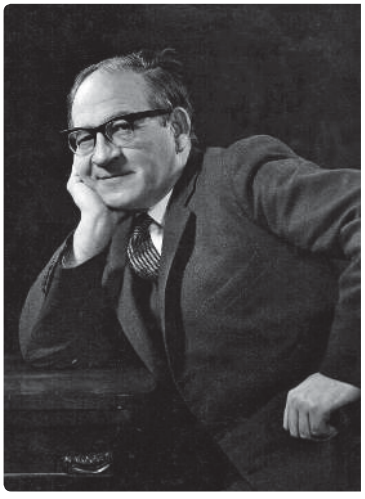
The largely successful flight-test programme of the prototypes led to an order for nine production aircraft (originally 18, halved for economic reasons), serials XS688–696, to be designated Kestrel F(GA).1s and operated by a Tripartite Evaluation Squadron (TES) funded and manned jointly by the UK, USA and the Federal Republic of Germany. For a time, the UK and Hawker's V/STOL interests were absorbed by the larger, supersonic P.1150/54 programme, inherited by the Labour government following its election in October 1964.

Labour entered office determined to reduce expenditure on defence, and the domestic military aerospace programme was a soft target. Hawker Siddeley was badly hit by the first round of cuts, but, in part to compensate the company for the loss of the P.1154, the government agreed to fund further development of the Kestrel, which would ultimately evolve into the larger, more powerful and more capable Harrier. In 1965 the government let contracts for the design, development and supply of six pre-production aircraft (XV276–281) to be designated P.1127 (RAF), the first of which made its maiden flight in August 1966.

The government's commitment to the P.1127 was always lukewarm, however. There were hopes that it might attract foreign orders, but some questioned "the whole philosophy of the need for V/STOL". The Kestrel trials were going well, however, and on balance there was nothing to weaken confidence in the aircraft as a close-air-support platform. It would also be available

Between the P.1127 prototypes and the Harrier came the Kestrel, three examples of which are seen here living up to the type's namesake by hovering over open lowland near the Tripartite Evaluation Squadron's base at West Raynham. A total of nine Kestrels was built for extensive flight testing by the pilots of the Luftwaffe, USAF, US Navy, US Army and RAF, under the command of the latter.

TAH ARCHIVE



ABOVE LEFT ***Fred Mulley, appointed Minister of Aviation on December 23, 1965, held the post until January 1967, when it became the Ministry of Technology.*** **ABOVE CENTRE** ***Denis Healey, Secretary of State for Defence from October 1964 to June 1970.*** **ABOVE RIGHT** ***Edward Shackleton, Minister of Defence for the RAF during 1964–67.***

before the Anglo-French Jaguar.[4] Its payload was limited but this was offset by the need to keep HSA's military concern in being and the tactical advantages of front-line availability.[5]

The Ministry of Aviation (MoA), under the leadership of Frederick Mulley from December 1965, also began to play the industry policy card: "Once again — as throughout the P.1127/P.1154/P.1150 story and others — we're hesitating to go forward or to branch off on another track. The reasons for hesitation are clear and comprehensible and cogent, but they are not new. The danger in this situation is that we can never hope to get British-developed aircraft at the time and of the kind we want if we show ourselves to be incapable of taking decisions and sticking to them". Failure to support the P.1127 might also endanger the proposed merger of HSA and BAC, as recommended in the Plowden Report.[6]

DOUBTFUL STRATEGIC VALUE?

The P.1127 project was far from a done deal. By late 1965 the decision was back in the "melting pot", not because of slippage or cost increases, but because the cost-effectiveness of the V/STOL concept remained questionable. The forthcoming Defence Review might in any event determine that the aircraft "cannot be afforded".[7] The industrial arguments did not impress Denis Healey, the hardnosed Secretary of State for Defence, who was preoccupied with the forthcoming Defence Review and by the effects of tight budgetary constraints imposed by the Treasury. In his view, and that of some of his officials, the Harrier was an expensive luxury of doubtful strategic value.[8]

In December 1965 an MoA paper considered the potential post-P.1154 mix of McDonnell F-4 Phantom II and P.1127, arguing that the latter would give unprecedented and unique flexibility in support of front-line forces.[9] An Air Ministry (AM) research and development (R&D) official was less positive, however, writing in January 1966 that the P.1127 was "an expensive way to deliver close air support; a better engine would improve performance but would delay [the] in-service date". Costs were close to the 1965 estimate, but it was clear that "we cannot afford to finance both this project and the Phantom as a combined Hunter replacement, particularly since the decision to adopt the [Rolls-Royce] Spey engine [for the Phantom] has added substantially to total costs". *[See the author's* Making A Pig's Ear From A Silk Purse *in* TAH25 *— Ed.]*

Reiterating the lack of a clear strategic rationale, the AM memo continued: "All in all therefore, the right course from the military and defence budget points of view is to dispense with the P.1127 now, as one which cannot be expected to provide reasonable value for money". Furthermore, any industrial fallout "ought not to be insuperable".[10]

Later the same month Edward Shackleton (Lord Shackleton), the RAF Minister, wrote to Healey, stating that the Air Staff had "taken exception to the strategic and tactical assumptions" in the AM memo. There was "no military advice that it should be cancelled. The fact is that we would be breaking into a new field, which will secure very significant operational advantages. I have not seen any good reasons advanced for abandoning V/STOL, on which a great deal of R&D has been expended over a long period of years. The effect on industry will be serious".[11]

Nevertheless, the air of uncertainty had a negative impact on the programme. Following a progress review in March 1966, an AM official commented that "the meeting was a depressing one, mainly because it was evident that most of the specialist directorates in the MoA were not prepared to waste much energy on the P.1127 until they had more evidence that the project

TAH ARCHIVE

ABOVE ***The first of the four Development Batch P.1127s, XP972 made its maiden flight on April 5, 1962. Its early test programmme explored the properties of what was known as the "fourth wing" to be fitted to the type, shown to good effect here, with extended leading edges and curved wingtips — known as "poor man's streamwise tips".***

was a going concern. There is now a great deal of inertia in the project".[12]

The paradox was noted by an MoD official: "The real trouble about the whole P.1127 project is not that it has gone wrong technically or escalated fantastically in financial terms during its development; the trouble is that the whole project may have been misconceived from the outset. Doubts on this point have never been entirely set at rest and the military case has never been proved to [full] satisfaction".

While the RAF liked it because, on balance, P.1127s in the hand were worth more than Phantoms "in the bush", the Royal Navy was quiet, and the Army ambivalent. Cancellation would cost £37m and Kingston might close, with some "hideous political complications". So the project was allowed to "roll on".[13]

In February 1966 the government, having finally cancelled the TSR.2, decided to buy the General Dynamics F-111 from the USA, adding even more to the military aerospace budget and incurring additional dollar-costs. This extra financial burden again called into question the future of the P.1127, but the Cabinet was quick to recognise its importance for "industrial reasons". Nevertheless, the government reserved the right to cancel the programme "should either technical developments or the escalation of costs make it desirable to do so".[14]

PRODUCTION OR CANCELLATION?

In March 1966 the production of 60 examples of the P.1127 (RAF), plus work to improve its Pegasus engine, were approved and it was evident that wider political sentiment was shifting in the P.1127's favour. Industrial and technological considerations were now driving the politicians. The AM noted that there was "a considerable politico-industrial element in the introduction of

BELOW ***Five of the nine Kestrels await a sortie with the Tripartite Evaluation Squadron (TES) at West Raynham in August 1965. The Tripartite Agreement between the UK, USA and West Germany was signed in Paris on January 16, 1963, on the basis of the cost of three aircraft and a third of development costs being borne by each nation.***

TAH ARCHIVE

TAH ARCHIVE

ABOVE ***Although bearing a legend reading "Hawker Siddeley P.1127" on its forward fuselage, this is in fact the first Kestrel, XS688, which made its maiden flight on March 7, 1964. The Bristol Siddeley Pegasus 5-engined Kestrel was fitted with a reconnaissance camera in an "eyelid" mounting in the extreme nose and a Ferranti gunsight.***

the P.1127 to the front line", and it would perhaps provide the basis for a more capable successor.[15]

At a meeting of the Weapons Development Committee in September 1966, the P.1127 was described as a "costly solution to meet part of the Army's requirement for close air support". The Army liked it because the RAF was unlikely to use it in any other role, but the prevailing strategic view foresaw a very short conventional phase in a European war, in which an asset like the P.1127 would add little deterrence value.[16] Nevertheless, the RAF felt that "there are two good reasons why we want the P.1127 in one form or another. We must have the Hunter replaced by the end of this decade and we believe in V/STOL as an operational technique. There is no alternative to the P.1127 in the timescale without shopping in the American market or by extending the life of the Hunter. The first I assume is out of the question politically and there is no evidence to suggest that the Hunter has a new lease of life". The Chief of the Air Staff endorsed this view and recommended the order for 60 aircraft.[17]

This was not yet the end of the matter. Although P.1127 development was moving along nicely, Healey was still looking for savings in the defence budget to meet the £2bn target agreed with the Treasury — and the P.1127 was in his sights. The Defence Budget was not yet finalised but "the P.1127 was a major candidate for cancellation in the latter stages of the Defence Review; the Chiefs of Staff confirmed at the time its low priority in relation to other major items in the defence equipment programme".

In general, the P.1127 was regarded as "a fighting aircraft rather than a deterrent", and Nato strategy still envisaged a rapid escalation to nuclear war. In Healey's view, the type's value as an industrial asset was also limited. Continuing with the P.1127 would imply cuts elsewhere. If money was to be saved, it had to go soon.[18]

To help Cabinet reach a decision, the Ministries of Aviation and Defence were asked to provide a joint evaluation, submitted on November 8, 1966. Cancellation was "unacceptable to the MoA", which cited the negative affects on the standing and confidence of industry, and the loss of a technology lead. The MoD argued that it could not afford the programme and remain within agreed budgetary targets.[19]

Minister of Aviation Fred Mulley argued strongly for the P.1127, warning of the wider industrial and political implications of cancellation. Killing it would be a grievous blow to industry, as "our declared policy is to provide an environment for a healthy and substantial

TAH ARCHIVE

ABOVE ***Kestrel XS694, coded "4" while with the TES, in its natural habitat operating from a dirt track in Thetford Forest. The TES was established on November 15, 1964, flying trials commencing on April 1, 1965. After eight months of tests involving operational procedures by day and night, the trials concluded on November 30 that year.***

aircraft industry". Stability was a key feature of future policy, and projects were to be cancelled only for technical reasons or gross cost increases. The P.1127 was the only advanced military project currently under development and was "designed to mitigate [the] effects of past cancellations".

The Prime Minister, Harold Wilson, had publicly accepted this case and "if it is now to be added to the list of cancelled projects, the effect on the confidence of industry and our standing abroad, particularly in Europe, would be little short of catastrophic". The government had made "firm pledges on behest of aircraft over the last year or so; therefore this is a critical test of our good faith". It would undermine any collaboration "from strength" by giving up a unique technology; "It is not something we can afford to throw away".[20]

This triggered a response from Healey. There was some uncertainty surrounding plans for future combat aircraft, notably the French commitment to a key element of the 1965 joint aircraft package with France, the BAC-led Anglo-French Variable Geometry (AFVG) aircraft *[to be covered by the author in a forthcoming article — Ed.]*. Nevertheless, at this point Healey felt he could not afford the P.1127: "I have reluctantly decided that I cannot support [Mulley] in recommending that the P.1127 project should proceed. I recognise the force of the Minister of Aviation's arguments, but I am convinced that the right course will be to cut our losses now".

Healey also questioned whether the P.1127 would "enable us to maintain within industry an airframe capacity of advanced technological character". Alternatively, the AFVG would ensure continuation of core design skills, whereas the P.1127 was "a production aircraft with no plans for further development". He concluded: "We cannot afford both a VG aircraft and the P.1127, and in this situation it is clear to me that the P.1127 should go forthwith".[21]

THE AXE RISES . . .

The fate of the P.1127 now hung on a meeting of the full Cabinet held in December 1966. Proceedings centred on a formal note by Cabinet officials, which summarised both the operational and technical issues. Technologically, the aircraft was still felt to have some marginal value. Termination, however, would help the MoD meet its annual budget target of £2bn, to be achieved by 1970. A total of 110 P.1127s would cost £130m more over a ten-year period than possible American alternatives, which could cost £40m in dollars. Operationally, the P.1127 was still deemed

desirable, but "the priority to be accorded to it on defence grounds alone is not such as to justify its continuation in view of the pressure on the Defence Budget".[22]

The case for continuation was largely based on industrial and technological grounds: "[It is] the only advanced military aircraft at present under development in the UK and the only major national aircraft project this government has initiated. Its adoption as a part-replacement for the Hunter was intended to mitigate the cancellation of the TSR.2, P.1154 and HS.681. If it were to be cancelled now the effect on the industry could be disastrous, particularly in the context of the uncertainty of the future of the AFVG. Although the balance of probability is that the French will agree to the continuation of the latter, this is not certain, and if they withdrew we should then have to consider whether or not to continue with the development of a simpler form of this aircraft in the UK alone. This uncertainty is relevant to the future of the UK industry".[23]

In particular, the P.1127 was HSA's main military project and there was a considerable risk that the UK might lose its second industrial group, as HSA's willingness to support a military aerospace division "could evaporate". From a technological perspective, the development of V/STOL was "the only part of aircraft technology in which the UK is in advance of the rest of the world. To abandon the P.1127 would be permanently to throw away that lead, with wider consequences for our technological capacity".[24]

Healey remained adamant that the P.1127 had to go: "The UK would be buying close air support for industrial and political reasons, at a higher cost than would be necessary for purely defence reasons". He also felt that carrying on would endanger collaboration. Healey had a powerful ally in the Chancellor of the Exchequer, James Callaghan (**ABOVE LEFT**), who also believed that the P.1127 was "not essential on defence grounds".

Regarding the industrial impact, cancellation would "admittedly be difficult in view of the

In June 1966 Hawker Siddeley test pilot Hugh Merewether conducted trials with P.1127 XP984 aboard* Centaur*-class light fleet aircraft carrier* HMS Bulwark*, demonstrating the type's extraordinary flexibility in any environment, from holes in the woods to pitching carrier decks. This aircraft survives today and is on long-term display at Brooklands Museum in Surrey.

TAH ARCHIVE

TAH ARCHIVE

ABOVE ***From struggling to retain interest from its home government, the P.1127/Kestrel, following its development into the unique Harrier, became a highly desirable item and attracted orders from other countries, most notably the USA, the type entering service with the US Marine Corps as the slightly modified AV-8A in the spring of 1971.***

government's previous commitments, and the substantial effect which cancellation was likely to have on the aircraft industry. The question was the extent to which the government should be prepared to subsidise the industry". As the type's export prospects did not appear to be such as to justify the heavy additional cost of continuation, it was clear that cancellation was fully justified.[25]

The Cabinet was divided on the issue. There was support for maintaining the cap on defence expenditure, and some were also opposed to subsidising the aerospace industry with resources that might be better used expanding social services. It was desirable that the UK maintain a technological lead, but it did not follow that this was true in all fields and there was "a good case for reducing the resources, both in skilled manpower and money, now deployed in the aircraft industry".

HARRIER RISING

In the event, the case for the P.1127 was made precisely on industrial and technological grounds. The project could not be "judged solely in defence terms; many of the most promising developments in the civil field had originated from defence projects, and the UK stood to lose another lead in a unique technology".[26] Ultimately, with Prime Minister Wilson siding with Mulley's industrial arguments, the Cabinet concluded that a firm order should be placed for 60 aircraft.[27] The P.1127 had escaped the axe.

Within two years of having been a "nearly project", the P.1127, named Harrier for RAF service in 1967, was elevated to a central role in the government's military deployment. The French decision to abandon the AFVG in 1967, followed by the UK's cancellation of its F-111 commitment early in 1968, left a big hole in Britain's short-term strike capabilities. Even more important, the adoption of "flexible response" by Nato, with its emphasis on a conventional "firebreak" before the introduction of nuclear warfare, increased the value of survivable and rapid close air support.

In 1969 the government increased its order for Harriers, with Healey describing how "more Harrier squadrons will have a very positive political impact on Allied opinion and will be an earnest demonstration of our support for the aims of the alliance, and a concrete example of our determination to participate directly in the defence of Europe.

"The occasion is also opportune for a gesture of this kind, when our European allies are looking to us for a lead in a climate of increasing anxiety about the resurgent Russian threat and possible American disengagement."

Furthermore, underlining this *volte face*, "in view of the priority I attach to the Harrier programme, I can assure my colleagues that it

will be accommodated within the revised Defence Budget ceilings".[28]

There were also signs of strong interest in the Harrier from the US Marine Corps (USMC), which asked HSA for a tender for 100 aircraft, worth up to £80m.[29] This led to an exchange of letters between Healey and his American opposite number, Secretary of Defense Clark Clifford, and some excited interchanges in London, with an enthusiastic endorsement from Prime Minister Wilson. Although these hopes were deflated by the Department of Defense's decision to exclude the Harrier from its FY1970 budget plan, pending the results of RAF in-service performance reports, American interest remained high.[30]

The USMC would ultimately acquire the Harrier (as the AV-8A) from 1971, which led to an Anglo-American joint development programme culminating in the more powerful AV-8B. *[See Chris Farara's* Sell It To The Marines *and Lon Nordeen's* Bird of Prey *in TAH10 — Ed.]*

The Harrier was not a unique operational aircraft. The Soviet Union developed an equivalent project, the Yakovlev Yak-38, but this depended on direct-lift engines and was deployed only in limited numbers. But, even with the 21st-Century arrival of the short take-off and vertical landing (STOVL) Lockheed Martin F-35B Lightning II, also with a separate direct-lift engine, the Harrier is unique in the elegance of its vectored-thrust propulsion system.

THE REST IS HISTORY

Ultimately, the Harrier and its AV-8A/B and Sea Harrier variants entered service with six countries — the UK, USA, Spain, India, Italy and Thailand — mainly as a maritime close-support aircraft, with a total of 834 deliveries. Regarded as a difficult aircraft to master, it offered the unusual ability to vector in forward flight — "viffing" — a sudden braking manœuvre offering unparalleled agility in combat. From narrowly having avoided Denis Healey's axe, the P.1127 went on to become the extraordinary Harrier, a true survivor that represented a unique operational asset for more than four decades.

1 To be fair, HSA's civil aircraft division was awarded the UK role in the Airbus, seeing off BAC's Two-Eleven and Three-Eleven projects (see *Airbus Industrie, TAH28)*. It also had the Nimrod to sustain its military business
2 Unless specified in an archive record, I shall refer to the P.1127. It was named Harrier in 1967, after the final decision to go ahead with the project
3 I am grateful to Bill King, ex-HSA Kingston, for his observations on the early days of the P.1127 programme
4 Air Ministry (AM) briefing July 29, 1965; The National Archives (TNA) ref AIR 2/17589
5 AM note of September 28, 1965, AIR 2/17589
6 The Plowden report of 1965 also recommended that all future aircraft (although not engines) should be based on international collaboration
7 Weapons Development Committee, November 1965, AIR 2/17589
8 Discussions regarding a merger of HSA and BAC were held, but had petered out by 1967; Ministry of Aviation (MoA) memorandum to Ministry of Defence (MoD), October 27, 1965, DEFE 13/439; also AM memorandum, January 5,1966, AIR 2/17590
9 MoA note, December 29, 1965, AIR 2/17590
10 AM draft memorandum, January 5, 1966, AIR 2/17590
11 RAF Minister memorandum to Secretary of State for Defence, January 1966, AIR 2/17590
12 AM note, March 8, 1966, AIR 2/17590
13 MoD note, October 6, 1966, DEFE 13/439
14 Cabinet Minutes, February 14, 1966, CAB/128/4; "P. 1127 Note" by the Prime Minister, Cabinet Minutes, February 11, 1966, CAB/129/124
15 AM note, September 28, 1966, AIR 2/17661
16 MoD note, October 6, 1966, op cit
17 DCAS memo, October 5, 1966, AIR 8/2492
18 Note from office of Secretary of State for Defence, November 15, 1966, AIR 8/2493
19 Joint memorandum by Minister of Aviation and Secretary of State for Defence, November 8, 1966, AIR 2/17661
20 Memorandum by Minister of Aviation, November 28, 1966, AIR 2/17661
21 Memorandum from Secretary of State for Defence, December 1, 1966, DEFE 13/551. The future of BAC Warton was also regarded to be vital. Warton's supersonic experience and facilities had to be defended; "Our conclusion therefore is that future military project decisions should be directed towards concentrating combat aircraft design with the BAC team at Warton, and that to preserve the nucleus of the present team it is essential to embark forthwith on a VG aircraft or its equivalent". Some RAF officers thought Healey's position to be somewhat unfair: "The multiplicity of mis-statements and distortions regarding this aircraft are such as to bring a blush even to the [Secretary of State's] cheek".
22 Note by Officials, December 20, 1966, CAB/129/127
23 Ibid
24 Ibid
25 Ibid
26 Ibid
27 Ibid
28 Paper by Secretary of State for Defence to Defence & Overseas Policy Committee, November 8, 1968, DEFE 13/651
29 Memorandum from Head of Defence Sales, November 12, 1968, DEFE 13/651; the prospect of an uprated engine seems to have turned information-gathering into a firm requirement
30 See files for December 1968–January 1969, DEFE 13/651

TWA'S Martin AIRCRAFT SKYLINERS

THE MARTIN 2-0-2 AND 4-0-4 IN TWA SERVICE

Often overlooked or forgotten altogether, TWA's fleet of twin-engined "Martin Skyliners" provided a vital stepping-stone for the airline during a critical period of its post-war expansion, from the wartime-era DC-3 to the magnificent Constellation. TWA specialist **JON PROCTOR** chronicles the careers of the 2-0-2 and 4-0-4 with the American carrier

IN THE SUMMER of 1946, having rejected earlier proposals from Curtiss-Wright for the CW-20, a suitably refined passenger version of the military C-46, the management at Transcontinental & Western Air (TWA) began seriously evaluating a new aircraft type to replace the company's ageing fleet of 70 Douglas DC-3s. Consideration was given to several models, including Boeing's high-wing Model 417, but Convair's new Model 110 drew the attention of Robert W. Rummel, one of TWA's top engineers and personal consultant to Howard Hughes.

The first of the American post-war airliners, this twin-engined low-wing state-of-the-art airliner was designed to incorporate 30 seats and an aft ventral "airstair" for passenger boarding and disembarkation. Although the Model 110, which made its first flight in July 1946, offered a top cruising speed of 275 m.p.h. (440km/h), its main drawback was its lack of cabin pressurisation.

American Airlines (AA) offered to purchase 100 examples of the Model 110, but only after the incorporation of extensive improvements, leading to the development of the pressurised Convair 240. Thus AA became the type's launch customer, agreeing on a price of $190,000 per aircraft (less engines), later reducing the order to 75 machines. It spelled the 110's demise; only one was built and it was broken up a year later.

MARTIN'S COMPETITOR

Around the same time, the Glenn L. Martin Company of Baltimore, Maryland, which had first studied a post-war DC-3 replacement in 1943, began marketing its new Model 2-0-2 and faster Model 3-0-3 "Mercury" to potential customers, including TWA. Both designs had a 36-seat capacity. The 2-0-2, the prototype of which made its maiden flight on November 22, 1946, was about 20 m.p.h. (32km/h) faster than the Convair 240 and was preferred by launch customer Northwest Airlines, which bought 20, the first of which entered service in October 1947, seven months ahead of American's Convair 240s.

Meanwhile, experiencing financial straits at the time, TWA was still more than two years away from purchasing twins. While the management tried to decide whether to order Convair 240s or Martin 2-0-2s, a twist of fate made the decision for Hughes and Bob Rummel's team. Following two non-fatal 2-0-2 accidents, another Northwest 2-0-2, NC93044, crashed in Minnesota on August 29, 1948, killing all 37 aboard. The investigation revealed a small structural flaw that had caused a wing failure and separation from the aircraft. Northwest temporarily grounded its 2-0-2 fleet, but, even after the type resumed service, large orders from other airlines disappeared.

Left with little choice, Martin cancelled both the 2-0-2 and 3-0-3 programmes. Finally, Northwest, having lost four more 2-0-2s in fatal accidents, grounded its fleet for good on March 17, 1951, not least because its pilots refused to fly the type. The remaining aircraft found their way to Southwest Airways (later Pacific Air Lines), Allegheny Airlines, California Central Airlines and Transocean Air Lines, among other carriers.

As a result, TWA approached Convair early in 1949 about a much-improved version of the Convair 240, or "Super 240". The manufacturer's managers requested permission to find another airline customer to justify the venture. Hughes in turn discussed the project with Eastern Air Lines' president Capt Eddie Rickenbacker, who expressed interest.

THE 4-0-4 AND 2-0-2A

Martin concurrently offered both airlines the remodelled and pressurised Model 4-0-4, and made available to TWA a dozen 2-0-2s still on the assembly line, to be structurally revised but still unpressurised. These redesignated 2-0-2As could be turned out rapidly, thereby helping TWA's acute need for modern twins. However, TWA and Eastern instead opted for the Convair Super 240 and readied contracts for a joint press conference in New York — only to have Convair President LaMotte T. Cohu withdraw the offer, stating that standard Convair 240s would be more than adequate. Unsurprisingly, both airlines swiftly turned back to Martin. Soon thereafter Cohu was relieved of his job at Convair.

The management at TWA signed a letter of intent on March 7, 1949, to purchase 30 examples

OPPOSITE PAGE ***An early TWA promotional shot of Martin 2-0-2A N93201, named*** **Skyliner San Francisco** ***and given Fleet Number "211". Delivered to the airline on July 14, 1950, it served until April 1958, when it was acquired by Allegheny Airlines.*** **ABOVE** ***TWA "Martin Skyliner" timetable dated September 1, 1950.*** JON PROCTOR / DAVID H. STRINGER

The launch customer for the Martin 2-0-2 was Northwest Airlines, which began services with the type in October 1947. This example, NX93037, was unusual in that it was initially built with a smaller fin and reduced dorsal fin, and outer wing sections without the type's standard pronounced dihedral, as seen here. It crashed on a training flight in Minnesota in October 1950.

AUTHOR'S COLLECTION

of the 4-0-4 and lease 12 unpressurised 2-0-2As, while Convair still continued to claim better performance from the 240. To settle the matter, Howard Hughes approved comparative flight tests between a modified and strengthened 2-0-2 and Convair's demonstrator 240, NC24927, which he later bought. The competition was undertaken at Hughes's facility at Culver City, California, in September 1949. Ultimately, TWA managers preferred the "Martinliner", particularly praising its single-engine performance on take-off, short-runway capability and claimed top cruising speed of 312 m.p.h. (500km/h).

With the issue finally resolved, TWA signed a firm contract on February 22, 1950, for the 12 Martin 2-0-2As on lease plus 30 Martin 4-0-4s. Soon after, Eastern ordered 35 4-0-4s with an option for 25 more, which it exercised a year later. Likewise, TWA ordered ten more 4-0-4s in August 1950, plus one for the exclusive use of Howard Hughes (N40437). The TWA order allowed return of the 2-0-2As on a one-for-one basis when the 20th and subsequent 4-0-4s were delivered, and TWA (which had changed its name from Transcontinental & Western Air to Trans World Airlines on May 17, 1950) would then operate the latter type exclusively.

Convair executives were shocked by the joint orders and quickly developed an improved Model 240A, which morphed into the Convair 340, the prototype of which first flew on October 5, 1951, with United Air Lines as the type's launch customer. In the end, along with the Model 440, Convair twins greatly outsold Martinliners.

The 2-0-2A featured a strengthened wing and fuselage, resulting in an empty operating-weight increase to 27,000lb (12,245kg), but providing a much-improved 43,000lb (19,505kg) maximum gross take-off weight and 41,000lb (18,600kg) landing weight, with a 13,000ft (4,000m) ceiling. An additional 350 US gal (1,325lit) avgas capacity brought the total to 1,350 US gal (5,100lit), with both over- and under-wing fuelling capability. Improved Pratt & Whitney R-2800-CB16 Double Wasp engines provided better performance and commonality with the soon-to-arrive 4-0-4's powerplants. An improved heating system and new navigational aids rounded out the 2-0-2A's attractive specifications.

INTO TWIN STRIPES

Martin was granted an amended Certificate of Airworthiness for the 2-0-2 on July 10, 1950, which also covered the 2-0-2A. Four days later TWA's first 2-0-2A was accepted at New Castle Airport at Wilmington, Delaware. Crew and station training immediately spread out to a dozen cities. Passenger service began on September 1, 1950, the 2-0-2A replacing the Boeing 307 Stratoliner on the Pittsburgh—New York service and the DC-3 on two multi-stop routes. To avoid any negative publicity with the tainted 2-0-2, TWA gave it the promotional name "Martin Skyliner", which it later carried over to the 4-0-4. Among other enhancements it was claimed to fly at "up to 100 m.p.h. faster speeds" than the DC-3.

The remaining 2-0-2As were quickly delivered, with all 12 in service by October 1, 1950, spanning the TWA route map from the Midwest to the East Coast. The timetable for November that year shows Martinliners calling at New York-LaGuardia, Philadelphia, Harrisburg, Pittsburgh, Columbus, Dayton, Louisville, Cincinnati, Indianapolis, Chicago, St Louis and Kansas City. Lacking cabin pressurisation, the type would not be scheduled west of Wichita, Kansas, which, along with Topeka, was added the following summer. By then, 2-0-2As had replaced all five Stratoliners and gradually took over from the DC-3s, some of which were used for all-cargo services.

TAH ARCHIVE

ABOVE ***The prototype 4-0-4 was in fact the second 2-0-2 prototype, NX93002, which was modified initially to become the 2-0-2A prototype in August 1947. Modified again in 1950 to the new 4-0-4 standard but without pressurisation and re-registered NX40400, the* de facto *4-0-4 prototype made its maiden flight on October 21, 1950, and remained with Martin thereafter.***

While the 2-0-2As provided a much-needed addition to TWA's fleet, the 4-0-4 offered several further enhancements. It was considerably heavier, with increased fuselage skin gauge and strengthened windows, enabling higher altitudes in pressurised comfort while cruising at 16,000ft (4,900m) with the cabin pressurised to a level equivalent to around 8,000ft (2,400m). The fuselage of the 4-0-4 was extended 13in (33cm) forward and 26in (66cm) aft, allowing a four-passenger capacity increase, with higher-strength seats able to withstand some 9g. Window exits were increased to six, including four over the wings. The view from the cockpit was improved, even with the 2-0-2A's small "eyebrow" windows removed. Summer and winter air-conditioning and enhanced soundproofing were also incorporated. The improved galley was located forward to port, with the coat closet and luggage compartment aft. As with the 2-0-2, the ventral airstair feature was retained.

The 4-0-4's combined cargo space increased from 257ft³ (7·27m³) to 344ft³ (9·74m³). With an empty weight of 29,100lb (13,200kg), the maximum take-off weight grew to 43,650lb (19,800kg) and later 44,900lb (20,365kg), although pilots insisted on using the lower of these figures. An improved, more-flexible "walking" undercarriage, similar to that fitted to Lockheed's Constellation, replaced the very stiff undercarriage that made smooth landings a challenge for 2-0-2A pilots. Finally, auto-feathering propellers and water injection were incorporated into the powerplants for improved performance from short runways, warm weather and high-altitude airports.

Martin engineers claimed that the 4-0-4 was being built for the future, and had been designed and stressed for prospective turboprop operation, "if and when this powerplant becomes available commercially". Only minor nacelle and control changes would be needed. But over at Convair,

Originally part of Northwest's 2-0-2 fleet, N93043 was acquired by Transocean Air Lines in August 1951 and was operated by the airline on behalf of Japan Air Lines from that October until it crashed into the volcanic Mount Mihara on the Japanese island of Izu Ōshima on April 9, 1952.

AUTHOR'S COLLECTION

TAH ARCHIVE

> “ TO TWA’S WORLD-PROVED DEPENDABLE FLEET HAS NOW BEEN ADDED THE MODERN MARTIN SKYLINER — THE VERY FINEST IN COMFORTABLE, CONVENIENT, ENJOYABLE AIR TRAVEL ”

ABOVE ***The first production 4-0-4, N40401, named* Skyliner Baltimore*, was delivered to TWA only on February 19, 1952, three months after its first 4-0-4 delivery, N40403, the previous November. Unlike the 2-0-2As, which were initially bare metal with TWA stripes and titles, the 4-0-4s were in the company’s distinctive white-fuselage scheme from the outset.***

LEFT ***“It’s swift . . . it’s luxurious . . . it’s spacious” — TWA’s brochure issued for the introduction of the “Martin Skyliner” extols the 2-0-2A’s virtues in no uncertain terms; “It gets you where you’re going fast — and on time!”*** AUTHOR’S COLLECTION

BELOW ***With its aft ventral airstair extended, 4-0-4 N40439, named* Skyliner Johnson City*, awaits its next complement of passengers at San Francisco after its introduction into service in September 1952. The airstair was hydraulically operated and completely self-contained, a boon on some of the more remote stops.*** WILLIAM T. LARKINS VIA AUTHOR

LOREN JONES VIA AUTHOR

ABOVE ***A rampful of TWA 4-0-4s — and one Constellation — on a very cold day at Pittsburgh, Pennsylvania. Nearest the camera is N40424, named*** **Skyliner Toledo** ***while with TWA, delivered on June 20, 1952, and flying its first service the same day. It plied its trade with TWA for a decade before going on to Piedmont in February 1962.***

2,700 e.s.h.p. turboprop engines were already being produced by the Allison division of General Motors and test flown on the Convair 240 prototype, while the Martin option was never taken up. The first true 4-0-4 prototype, N40400, made its first flight on October 21, 1950.

4-0-4 DELAYS

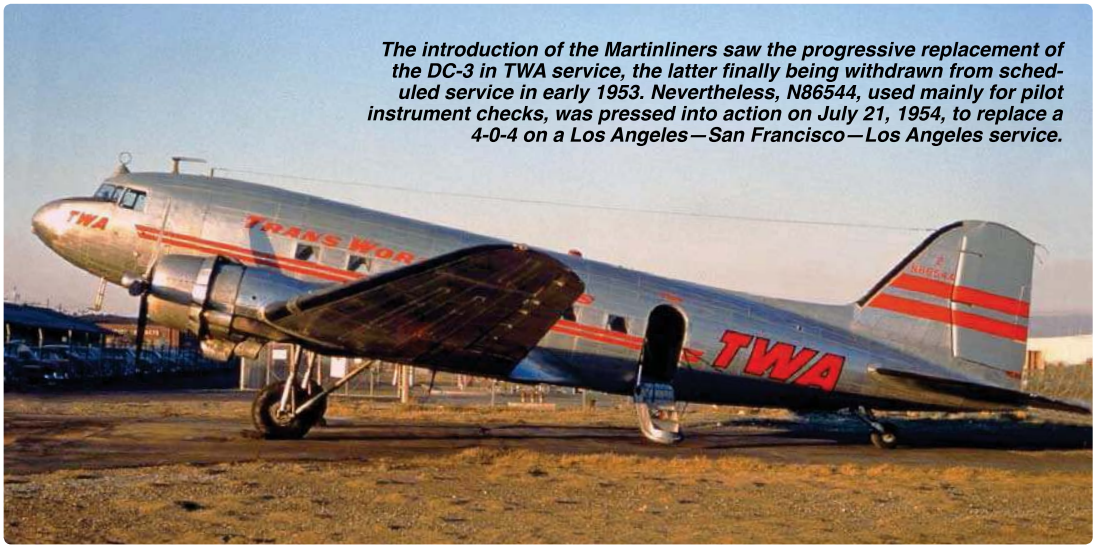
With TWA's DC-3 fleet reduced to 51 by the spring of 1951, the airline's 4-0-4s were quickly moving down the assembly lines at Martin's factory at Baltimore, but, owing to modifications, deliveries were pushed back several months. The first of TWA's 4-0-4s, N40401, was rolled out in early July and made its maiden flight on the 27th, wearing white paint on the sides and fuselage top — a new look for TWA that was soon adopted on its arriving Super Constellations, and later the entire fleet.

Although the 4-0-4's Type Certificate, 1A7, was awarded on October 5, 1951, TWA's first delivery (N40403) did not take place until a month later, on November 9, followed by N40404 on November 29. In addition to pilot-training work, a few publicity flights were conducted, including one for the Kansas City Chamber of Commerce during the first week in December.

Inaugural TWA 4-0-4 services began on January 15, 1952, connecting Kansas City with New York and Washington DC, with stops at Columbus, Dayton, Indianapolis, St Louis, Philadelphia, Pittsburgh, Cincinnati, Louisville, Chicago and Wheeling, with Cleveland added in March. The DC-3 replacements nearly doubled seat capacity to many under-served cities. By April 1952 TWA 4-0-4 service had spread to Wichita, Harrisburg and Newark. Some 25 4-0-4s were serving in TWA's fleet by the end of June that year, with new services to Baltimore, Wheeling, Louisville, South Bend and Fort Wayne; Peoria and Zanesville flights began in July, along with Boston, replacing a DC-3 flight to Chicago with stops at Albany, Wilkes-Barre/Scranton and Pittsburgh.

The 4-0-4 also joined Detroit to the TWA route map, as part of a unique interchange service with Delta Air Lines. First begun in 1948, TWA crews operated from Detroit to Columbus and Cincinnati, where Delta personnel took over for trips south to multiple destinations. Beginning on March 1, 1952, the same routing utilised Martin 4-0-4s while other flights within the framework used Delta Convair 340s. Thus for the first time TWA crews flew Convair twins and Delta crews flew the Martins. That May TWA announced the outright purchase of its 2-0-2As, undertaken to handle the steady increase in passenger traffic, building its Martin fleet to 52 aircraft.

Even with the addition of new Super Constellations in May and June 1952, Martinliners contributed in no small way to June's 16 per cent year-on-year increase in passenger traffic. In total 1,743,000 miles were flown by TWA's 4-0-4s



The introduction of the Martinliners saw the progressive replacement of the DC-3 in TWA service, the latter finally being withdrawn from scheduled service in early 1953. Nevertheless, N86544, used mainly for pilot instrument checks, was pressed into action on July 21, 1954, to replace a 4-0-4 on a Los Angeles—San Francisco—Los Angeles service.

BOB ARCHER VIA AUTHOR

during the first six months of 1952, while 2-0-2A miles were up 10·8 per cent year-on-year.

As the last of TWA's 4-0-4s was delivered on August 13, 1952, a great reduction of DC-3 service spelled the fast-approaching retirement of the airline's Douglas fleet. From 21 daily flights in the July 1, 1952, timetable, the DC-3's schedule dropped to only six with the September 28 fall changeover, including a single 13-stop flight in each direction between Kansas City and San Francisco. Unable to handle the Martinliners, the Grand Canyon service was suspended for the winter and did not resume.

Except for a few all-cargo versions, all but six of TWA's DC-3s, retained for pilot instrument checks and engine carriers, were withdrawn from scheduled service in January 1953; the last were sold off by December 1957. In turn, a handful of small towns received new Martinliner service, including Quincy-Hannibal on the Illinois/Missouri border, after which a 2-0-2A was named.

WESTWARD BOUND

A western expansion plan was enacted using TWA 4-0-4s on January 6, 1953, routes continuing beyond Wichita to Amarillo, Albuquerque, Santa Fe, Winslow, Las Vegas, Los Angeles, Burbank, Fresno and San Francisco, just as the DC-3s stood down. Well-equipped for "mountain stations", the 4-0-4s expanded frequent schedules within the western region as well, between Los Angeles, Las Vegas, Phoenix and Albuquerque, while a single daily through-flight from the Midwest continued on from Los Angeles to San Francisco, albeit with no local passengers allowed.

On July 21, 1954, with a Martinliner out of service, the LA-based DC-3 pilot trainer was substituted on the Los Angeles—San Francisco—Los Angeles segments, arguably marking TWA's last "scheduled" DC-3 passenger service.

An additional interchange service began on April 1, 1953, using TWA 4-0-4s from New York to St Louis via Pittsburgh and Indianapolis. Chicago & Southern Air Lines (C&SAL) crews then took over for a St Louis—Houston portion via Memphis and Shreveport. Another service operated with C&SAL Constellations, stopping only at Pittsburgh and St Louis.

In July 1953 TWA began scheduled 5min "short-stops" at smaller stations. Crew and through passengers remained aboard and the starboard engine was kept running on these "fuelled-through" layovers. When making up lost time, stations claimed 2–3min stops, and

Martin 4-0-4 N40424 taxies past a Chicago Helicopter Airways Sikorsky S-58 at Chicago-Midway in July 1959. A total of 103 4-0-4s was built; 60 for Eastern Air Lines, 41 for TWA and two for the US Coast Guard as VIP transports, designated RM-1Zs.

MEL LAWRENCE / GEORGE HAMLIN COLLECTION

VIA AUTHOR

Displaying the type's steerable nosewheel to good effect, 4-0-4 N40401 prepares to board its next flight of passengers. In February 1960* Skyliner Baltimore *lost a wheel on take-off at Chicago and had to make a belly-landing at NAS Olathe, Kansas. It was ultimately written off after a propeller reversal during a single-engined landing at Wilmington, North Carolina, in August 1962.

even a 1min pause at Wilkes-Barre/Scranton was accomplished when two passengers got off and four got on!

After the production of 103 4-0-4s had been completed in early 1953, Martin found that building the type had resulted in a $17·5m deficit and a total programme loss of $45m on its commercial aircraft programme. As a result, TWA's fleet was then capped unless Convair twins were considered. However, in October 1953 TWA President Ralph S. Damon stated at a management club meeting that buying a new twin-engined type did not make sense for TWA. Instead, four-engined aircraft would be the focus of future purchases in order to produce greater revenue on longer segments, rather than minimal returns on the short sectors flown by the Martins.

Nevertheless, the Martinliner fleet served a vast short-haul schedule for the next few years, over segments as short as the 63 miles (100km) between Dayton and Cincinnati, up to the longest non-stop sector of 460 miles (740km) from Pittsburgh to Chicago. Even shorter was the 50-mile (80km) leg between Albuquerque and Santa Fe. Some schedules, such as Kansas City—St Louis, included a meal service, and copilots often came back to assist the hostess.

By April 1956 TWA Martins no longer flew the Los Angeles—San Francisco segment, leaving a single Kansas City—Los Angeles 4-0-4 flight, with six intermediate stops. The 4-0-4 operated eastbound only as far as Albuquerque, with a Phoenix stop. Hartford/Springfield (Bradley International Airport) in Connecticut opened on June 5 that year, with Martins flying the segment to and from New York-La Guardia.

MISHAPS, INCIDENTS AND ACCIDENTS

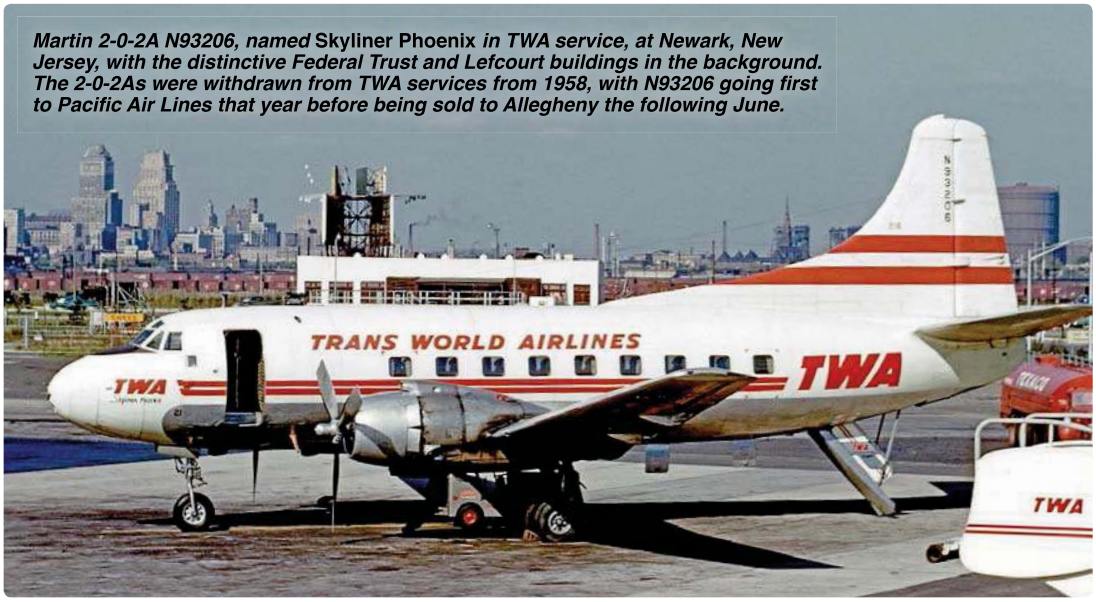
Although the TWA 2-0-2As suffered minor incidents, mostly undercarriage failures, only one was lost. On January 12, 1955, N93211 collided with a privately owned DC-3 shortly after take-off from Cincinnati; 15 people were killed, including two on the DC-3. The subsequent investigation revealed that the DC-3 pilots entered the airport control zone without clearance.

As with the 2-0-2As, the 4-0-4 fleet also suffered from several undercarriage collapses and other minor accidents, and most were repaired. Three resulted in hull losses, however. On February 19, 1955, 9min after taking off at 0705hr from Albuquerque on a flight to Santa Fe, TWA Flight 260 (N40416) struck a peak of the fog-obscured Sandia Mountains in New Mexico, killing all 13 passengers and three crew. The captain was

MARTIN 4-0-4 DATA

Powerplant 2 x 1,800 h.p. Pratt & Whitney R-2800 CB16 Double Wasp 18-cylinder two-row radial air-cooled piston engines driving a Hamilton Standard three-bladed reversible propeller of 13ft 2in (4·01m)-diameter

Dimensions		
Span	93ft 3in	(28·44m)
Length	74ft 7in	(22·75m)
Height	28ft 5in	(8·61m)
Wing area	864ft²	(79·89m²)
Wheel track	25ft 0in	(7·62m)
Weights & loadings		
Empty (equipped)	29,126lb	(13,223kg)
Max take-off	43,650lb	(19,817kg)
Max wing loading	50·5lb/ft²	(247kg/m²)
Power loading	9·1lb/h.p.	(4·12kg/h.p.)
Performance		
Maximum speed at 14,500ft (4,400m)	312 m.p.h.	(500km/h)
Cruising speed	280 m.p.h.	(448km/h)
Stalling speed	79 m.p.h.	(127km/h)
Service ceiling	29,000ft	(8,850m)
Normal range	1,080 miles	(1,730km)



Martin 2-0-2A N93206, named **Skyliner Phoenix** *in TWA service, at Newark, New Jersey, with the distinctive Federal Trust and Lefcourt buildings in the background. The 2-0-2As were withdrawn from TWA services from 1958, with N93206 going first to Pacific Air Lines that year before being sold to Allegheny the following June.*

VIA AUTHOR

initially blamed for intentionally deviating from course, but two appeals finally vindicated him when it was shown that the aircraft's previous redundant-compass-system failures, causing 45° erroneous heading indications, may well have been at fault. In addition, it was argued that no pilot would intentionally turn in the direction of a mountain. The Civil Aeronautics Board listed the probable cause as "a deviation from the prescribed flight path for reasons unknown" and the reputation of the pilots was restored. Tragically, just a month earlier, a rewiring change to display headings independently to each pilot had been approved, including a red warning light indicator in the case of conflicting readings. But it came too late for Flight 260.

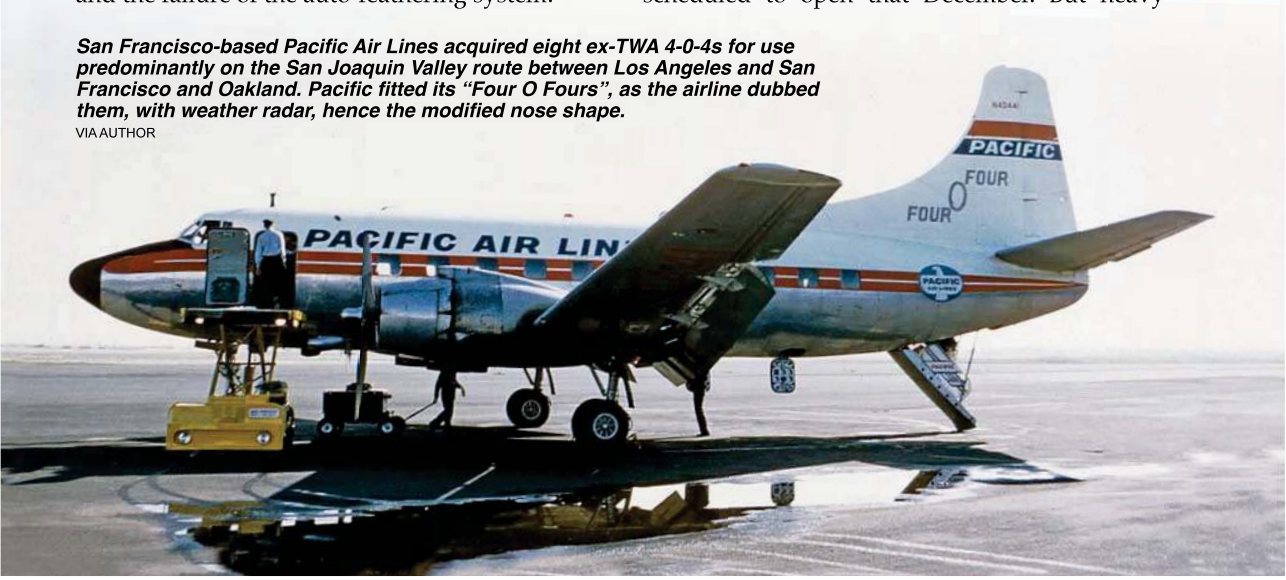
A second hull loss occurred on April 1, 1956, when Flight 400 (N40403) crashed after take-off from Pittsburgh, killing the hostess and 21 of the 33 passengers and seriously injuring the pilots. The cause was traced to an engine-fire warning and the failure of the auto-feathering system.

Barely six months later N40404 ran off the runway at Las Vegas following an engine failure, which had forced the aircraft to return after departure. Nobody was injured but the aircraft was substantially damaged and written off.

One TWA Martin 4-0-4, N40401, escaped serious damage on take-off from Chicago, bound for Peoria, Illinois, on February 28, 1960, after losing its two port mainwheel tyres. Following a diversion to the Naval Air Station at Olathe, Kansas, the Martin successfully landed on its belly after the runway was foamed with fire retardant. Nobody was hurt and the aircraft was returned to service following repairs.

SOLDIERING ON — AND RETIREMENT

TWA's remaining Martinliner fleet remained active until the 2-0-2As began to be withdrawn during January–March 1958, to be offered for sale. Although retired, one 2-0-2A was used on a survey trip in May 1958 to new Florida stations scheduled to open that December. But heavy



San Francisco-based Pacific Air Lines acquired eight ex-TWA 4-0-4s for use predominantly on the San Joaquin Valley route between Los Angeles and San Francisco and Oakland. Pacific fitted its "Four O Fours", as the airline dubbed them, with weather radar, hence the modified nose shape.

VIA AUTHOR

WILLIAM T. LARKINS VIA AUTHOR

Many of the former TWA Martinliners went on to have extended careers with second-line operators, including 4-0-4 N40428, previously* Skyliner South Bend, *which was acquired by the Outboard Marine Corp of Waukegan, Illinois, in January 1960 and used as an executive transport. The type was little-seen in Europe, however, Frank Sinatra's N40434, named* Christina, *being a rare exception.

traffic resulted in all-Constellation services, without Martins.

Over the following 16 months the 2-0-2As found a variety of homes. Three were leased via California Airmotive to Texas-based Lone Star Airlines. Another six were sold over a two-year period to Allegheny, which operated them in conjunction with earlier 2-0-2 models, and four were leased to Southwest Airways, later to be renamed Pacific Air Lines. Some went on to serve in Mexico, Central and South America. The sole 2-0-2A survivor, N93204, formerly of TWA, now resides at the Aviation Hall of Fame Museum in Teterboro, New Jersey.

By early 1960 low passenger-traffic markets, in which even the Martin 4-0-4s could not justify continuing service, led to the inevitable station closings, such as Peoria on April 22 that year. In June Toledo, Ohio, closed when TWA's operating authority between Detroit and Cincinnati via Toledo, Columbus and Dayton was transferred to Lake Central Airlines. Constellations took over at Albany in New York state on October 30, plus Wilkes-Barre/Scranton and Binghamton on November 17, but Topeka closed the same day. Reading, Williamsport, Wheeling and Santa Fe followed, along with three Indiana cities: Fort Wayne, South Bend and Terre Haute.

The last of TWA's 19 remaining Martinliners were finally retired on April 29, 1961. On that day the appropriately numbered Flight 404 flew from Baltimore to St Louis, with stops at Washington-National, Columbus, Dayton and Indianapolis. The remaining TWA 4-0-4s were stored at Fairfax Airport, Kansas City, the airline then becoming the first of the "big four" to operate an all four-engined fleet.

Piedmont Airlines took the lion's share of 4-0-4s in 1962, comprising 24 aircraft, some acquired indirectly through intermediate sales. Four Pacific Air Lines 2-0-2As came back to TWA, in exchange for the same number of the stored 4-0-4s; four more were bought by Pacific, rounding out Pacific's fleet to eight. The returning 2-0-2As were then sold on to Allegheny. Several 4-0-4s went to private owners and travel clubs, along with leasing companies. Frank Sinatra purchased N40434 for his own use and records show it may be the only Martinliner to call in at London and other European destinations.

SHORT BUT SWEET

By the standards of today, the "Martin Skyliners" enjoyed a comparatively short career with TWA, accruing barely eight years in service, as against 21 for the Constellation fleet. For the 2-0-2As and 4-0-4s, however, this was a period of growth, before higher-capacity, longer-range Connies made them obsolete. At the same time, the Local Service airlines acquired a substantial number of them, along with small towns across the TWA system. *[See David H. Stringer's two-part series* How America's Local Airlines Put Main Street On The Map *in* TAH3 *and* TAH4 — *Ed.]*

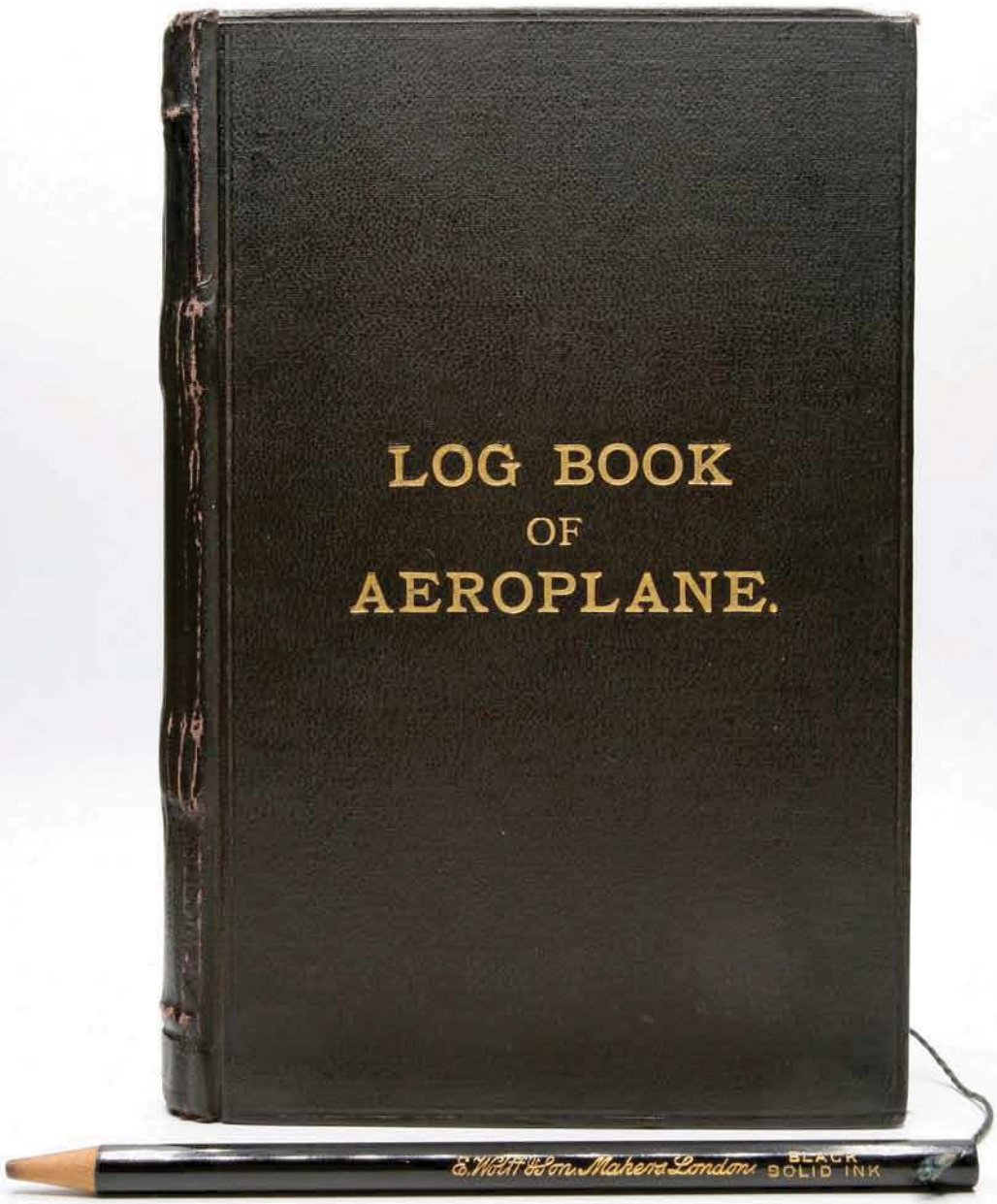
Although rarely receiving the plaudits awarded to their more famous counterparts, TWA's sturdy and reliable Martinliners replaced the entire DC-3 and Stratoliner fleets, along with DC-4s, in domestic service, and performed yeoman service for their master.

ACKNOWLEDGMENTS *The Editor would like to thank David H. Stringer, George Hamlin and Tom Singfield for their invaluable help with the preparation of this article*

THE WORLD'S FIRST..?

Sir Stanley White's pioneering aviation logbook

In early 1911 George Stanley White, one of the founders of the British & Colonial Aeroplane Company (later to become Bristol), created what may well be the world's first commercially available aviation logbook. His grandson, **SIR GEORGE WHITE Bt**, leafs through one of the few surviving examples, originally owned by French pioneer Henri Jullerot



GEORGE STANLEY (later Sir Stanley) White (1882–1964) was a co-founder of The British & Colonial Aeroplane Company (to become the Bristol Aeroplane Company in 1920) with his father and uncle in February 1910. While his father, Sir George White, 1st Baronet (1854–1916), was an irrepressible extrovert, whose exploits in developing advanced transport systems of all kinds were broadcast far and wide, Stanley took after his mother, and was a shy and reserved man. After his death in 1964 his daughter-in-law described him not only as the least pompous man she had ever met, but also the quietest.

Given that by the end of the Second World War the Bristol Aeroplane Company employed some 60,000–70,000 people, Stanley may well have needed some time for silent contemplation; and, if so, he used it well. He was, however, blessed with a dry sense of humour, which, when he was moved to use it, was often self-deprecating. In this vein he would sometimes claim to be "a published author", as in March 1911 he had created and marketed a rather curiously-titled publication called, simply, *Log Book of Aeroplane*.

These hardbacked books, covered in black waterproof cloth, weighed precisely 1lb (0·5kg), and included a pencil of "black solid ink" attached by a string. The endpapers and fore-edges were magnificently marbled in maroon, yellow, blue and green. The title page confirmed that the concept was that of "G. Stanley White, Managing Director, The British and Colonial Aeroplane Company, Ltd", further noting that they had been printed in Bristol by the eccentric but much-admired printer and publisher Edward Everard of Broad Street. The price per copy was 7s 6d.

THE PERFECT LOGBOOK

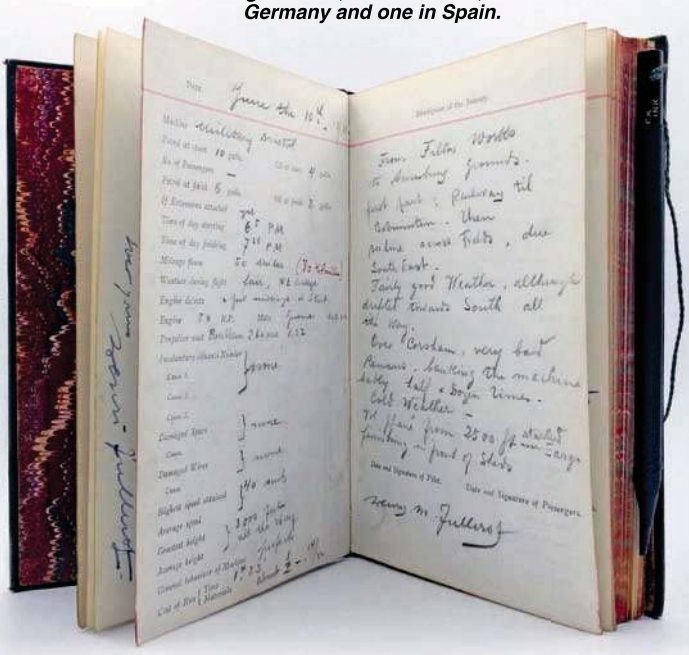
In a short preface in each, Stanley wrote that "the object of this book is to provide a means of recording the flights of an aeroplane, together with a *resumé* thereof in each case. It does not pretend to cover every possible point, but to afford a useful memorandum. The printing of this book is unaffected by damp, and a pencil is provided which should give a copy also unaffected by dampness. For those who wish a lighter book there is published a lightweight copy on bank paper".

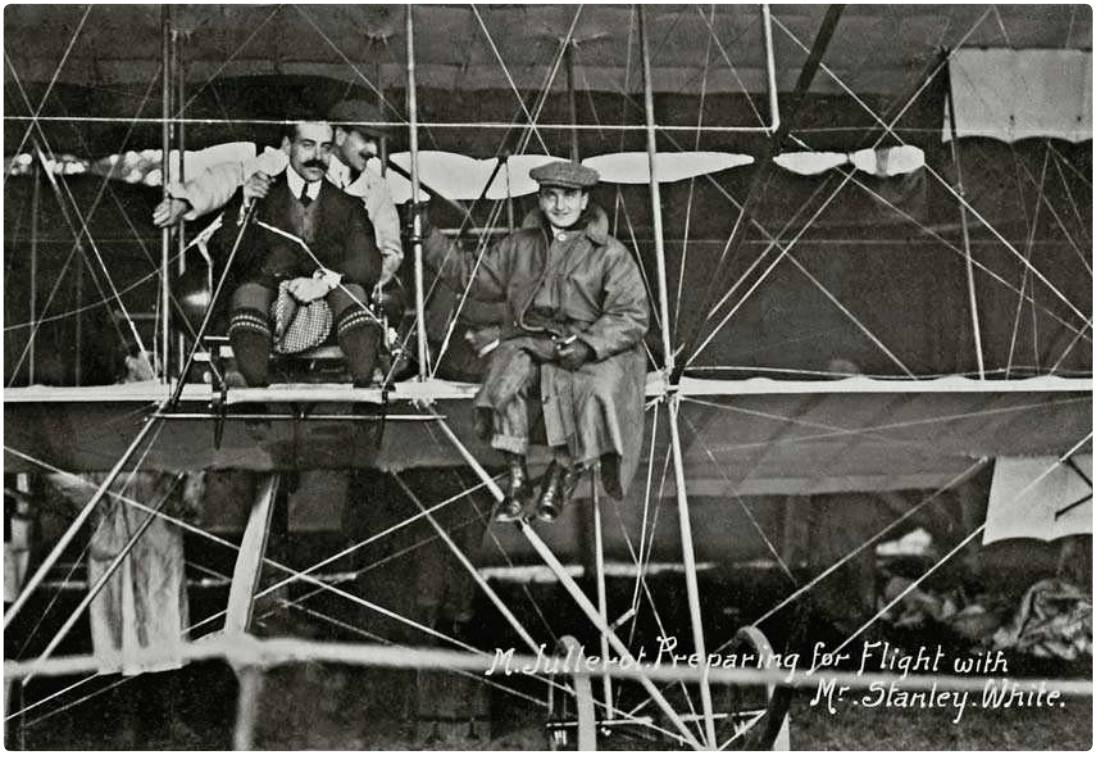
Each flight is afforded two pages. On the left-hand page spaces are set out for the date of the adventure and the machine flown. Then comes a record of petrol and oil at the start and

ALL PHOTOGRAPHS VIA AUTHOR

ABOVE ***Sir George Stanley White, 2nd Bt, was born on July 31, 1882, son of the Bristolian businessman, stockbroker and transport pioneer Sir George White. Stanley, as he preferred to be known, went on to become Deputy Chairman of the Bristol Aeroplane Co.***

BELOW ***Seen here open and displaying its beautifully marbled endpapers and fore-edges, Jullerot's example of Stanley's* Log Book of Aeroplane *contains the details of four flights he made between June 1911 and August 1913; two in the UK, one in Germany and one in Spain.***





ABOVE ***Henri Jullerot sits at the controls of a Bristol Boxkite with Stanley White perching on the wing beside him, on the occasion of a flight from Durdham Down in Bristol in November 1910. Jullerot had joined the company as a test pilot shortly before, and was despatched to India with two Boxkites as a demonstration pilot that December.***

finish of the flight, together with a note of the number of passengers and whether or not "extensions" had been attached to the wings. The time of starting and finishing the flight was then recorded, followed by the mileage flown and a brief description of weather encountered. The engine type and size was noted, complete with the diameter and pitch of the propeller.

Generous space is provided for entering details of up to three "involuntary descents" and their causes, followed by spaces to describe any damage to spars and wires. Towards the bottom of the page come statistics: the highest speed obtained; average speed; average height and greatest height reached. Finally, a pilot could note the "general behaviour of the machine" and the "cost of the run" in time and materials.

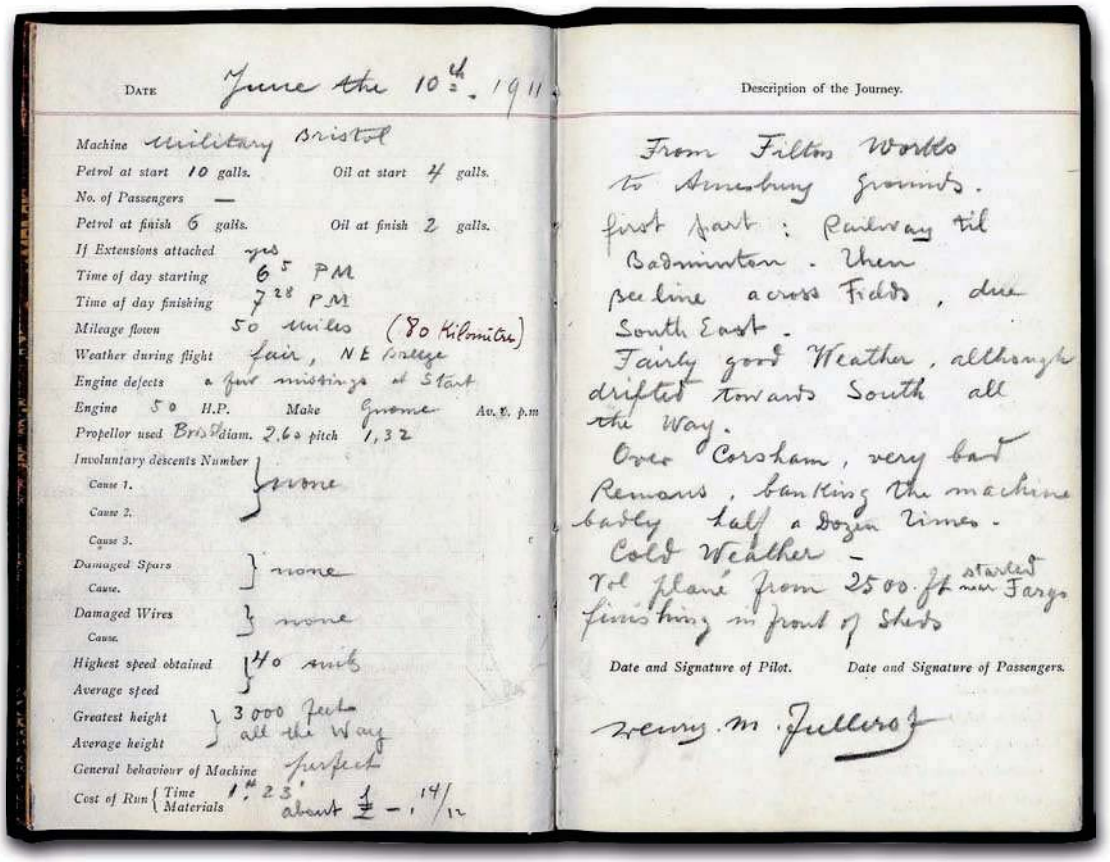
Three-quarters of the right-hand page is devoted to a "Description of the Journey", leaving space at the bottom for the signatures of the pilot and any passengers.

RARE SURVIVORS

Two copies of the logbook are known to have survived. One is unused, but the other has eight completed pages. The pilot and original owner of the second book was the celebrated French pioneer aviator Henri Marie Jullerot (1879–1959), holder of French Brêvet No 61, who had been brought over to England by Sir George and Stanley White in 1910 to test-fly their aircraft and teach at the extremely successful flying schools that they had founded at Brooklands in Surrey and Larkhill, near Stonehenge in Wiltshire .

The first entry in Jullerot's logbook records a flight from "Filton Works to Amesbury Grounds", i.e. from British & Colonial's headquarters at Filton, just north of Bristol, to Larkhill. This took place in the early evening of June 10, 1911. The aircraft was a Military Bristol Biplane (Boxkite), fitted with upper-wing extensions. The 50 h.p. Gnome engine consumed 4gal (18lit) of petrol and 2gal (9lit) of oil over the 50 miles (80km) flown. Although the engine suffered "a few missing at the start", Jullerot, who was flying alone, regarded the general behaviour of the machine as "perfect", there having been no breakages nor involuntary landings. In fair weather, with a north-easterly breeze, he had maintained a height of 3,000ft (900m). He estimated the cost of the journey, which took 1hr 23min, at a little over 14s 0d.

In his "Description of the Journey", Jullerot records that he followed the railway line until he reached Badminton. He then "took a bee line across fields, due South East". The weather, he reported, was "fairly good", although he "drifted towards South" all the way. Over Corsham he suffered "very bad *remous* [swirling], banking the machine badly half a dozen times", but he


DATE June the 10th. 1911

Description of the Journey.

Machine Military Bristol
Petrol at start 10 galls. Oil at start 4 galls.
No. of Passengers —
Petrol at finish 6 galls. Oil at finish 2 galls.
If Extensions attached yes
Time of day starting 6.5 PM
Time af day finishing 7.28 PM
Mileage flown 50 miles (80 Kilomitres)
Weather during flight fair, NE breeze
Engine defects a few misfires at Start
Engine 50 H.P. Make Gnome Av. r. p.m
Propellor used Bristol diam. 2.60 pitch 1,32
Involuntary descents Number
Cause 1. } none
Cause 2.
Cause 3.
Damaged Spars } none
Cause.
Damaged Wires } none
Cause.
Highest speed obtained } 60 mils
Average speed
Greatest height } 3000 feet all the Way
Average height
General behaviour of Machine perfect
Cost of Run { Time 1.11.23' about 1/2 - 14/12
Materials

From Filton Works to Amesbury grounds.
first part: Railway til Badminton. Then decline across Fields, due South East.
Fairly good Weather, although drifted towards South all the Way.
Over Corsham, very bad Remous, banking the machine badly half a Dozen times.
Cold Weather —
Vol plané from 2500 ft started near Fargo finishing in front of Sheds

Date and Signature of Pilot. Date and Signature of Passengers.

Henry M. Jullerot

ABOVE ***The opening entry in Jullerot's logbook details a flight in a "Military Bristol" — essentially a Boxkite with enlarged fuel tanks and three rudders — from Filton to "Amesbury Grounds", the site of British & Colonial's flying school at Larkhill. Fitted with a 50 h.p. Gnome, this machine may have been No 37 or No 38, one of four built to a March 1911 War Office contract.***

finished the flight overhead Stonehenge with a flourish: "*Vol plané* [gliding flight] from 2,500ft [750m], started near Fargo [Military Camp], finishing in front of sheds".

The second flight recorded in the logbook was flown on June 28 the same year and consisted of a 40-mile (64km) circuit beginning and ending at Larkhill. The aircraft was "Bristol Biplane No 9", which on this occasion carried a passenger. This was Professor Petavel, described in a later ink annotation on the page by Jullerot as "the late Sir John Petavel, who has been Director of NPL at Toddington [sic] many years until his death". It was in fact Sir Joseph Ernest Petavel (1873–1936), then Beyer Professor of Engineering at Manchester University, who later became not only Director of the National Physical Laboratory at Teddington in Middlesex, but, from 1917, Chairman of its Advisory Committee for Aeronautics.

TO THE CONTINENT

The third recorded flight in the book relates to a demonstration flight made in Germany. The entry is undated but the flight clearly took place in the first months of 1912. It began and ended at Döberitz, west of Berlin, taking in Wannsee, Potsdam, Charlottenburg, Spandau and other districts around the capital. The aeroplane, whose general behaviour Jullerot described as "splendid", was a two-seat Bristol-Prier monoplane, almost certainly No 74, then being demonstrated in Germany by Howard Pixton. His passenger was *Leutnant* Karper of the Lothringer Regiment. There were no involuntary descents nor any other mishaps and the aircraft averaged 60 m.p.h. (96km/h).

The final recorded flight took place in Spain between 0520hr and 0545hr on August 18, 1912, or more likely 1913, the date being overwritten in "black solid ink". Jullerot described his aircraft as a "Bristol Mono biplane", almost certainly one of the eight Bristol B.R.7s built, probably No 153, the "general behaviour" of which he generously characterised as "fair". His passenger was Colonel Pedro Vyves-y-Vych. The two men took off from Cuatro Vientos in Madrid, but the flight ended abruptly when the 50 h.p. Gnome engine "stopped completely" owing to a short circuit, resulting in damage to the chassis and longerons. Jullerot later annotated the page as follows:

"The passenger was the Chief of the Spanish

LEFT ***Autographed for Stanley White by Jullerot, this photograph shows the latter in the rear seat of a Bristol-Coanda Monoplane at Larkhill in February 1913. Jullerot flew with the French and British air services during the First World War and later became a special director of aviation for Vickers and Supermarine.***

BELOW ***Jullerot at the controls of a Bristol-Prier Monoplane, similar to the two-seat example he demonstrated in Germany in early 1912. The fine displays of the aircraft by Howard Pixton and Jullerot led to the formation of the Deutsche Bristol-Werke at Halberstadt that year.***

Air Force, who later as General Vives-y-Vych was a Minister of Primo de Riveira. I hope he is still alive, though we nearly got killed together."

POSTSCRIPT

Fascinating though these pages are, the most moving section of the book is an inscription written in ink on the flyleaf in Jullerot's confident hand, dated May 3, 1940. It is addressed to George S.M. White (1913–1983), Sir Stanley White's son, who became responsible for aircraft production at Bristol during the Second World War, later serving as joint managing director with his father.

"My dear George," Jullerot begins in perfect English (which he apparently spoke with a strong Wiltshire accent), "your father Sir Stanley gave me this book a few years before you came to this world. It was the first Aviation Log Book ever made. In it I recorded only a few flights: the first air link between Filton and Lark Hill [sic]; some local flights over Salisbury; one round Berlin and Madrid to Toledo & crash. I leave it in the original pencil, which I sharpened only today, after 29 years' neglect.

"I am sorry the book was printed only after I came back from India [1910–11], so [those] modest but historic little events are unrecorded therein. I hope this will have to you a sentimental value, as it has to me, the more so that it will give you another proof of the sharp foresight your grandfather and your father have had in making such a thorough job of what their and my contemporaries thought sheer madness. God Bless, and all the best to you and those dearest to you, ever yours, Henri Jullerot."

R. & M. No. 2491
(5520)
A.R.C. Technical Report

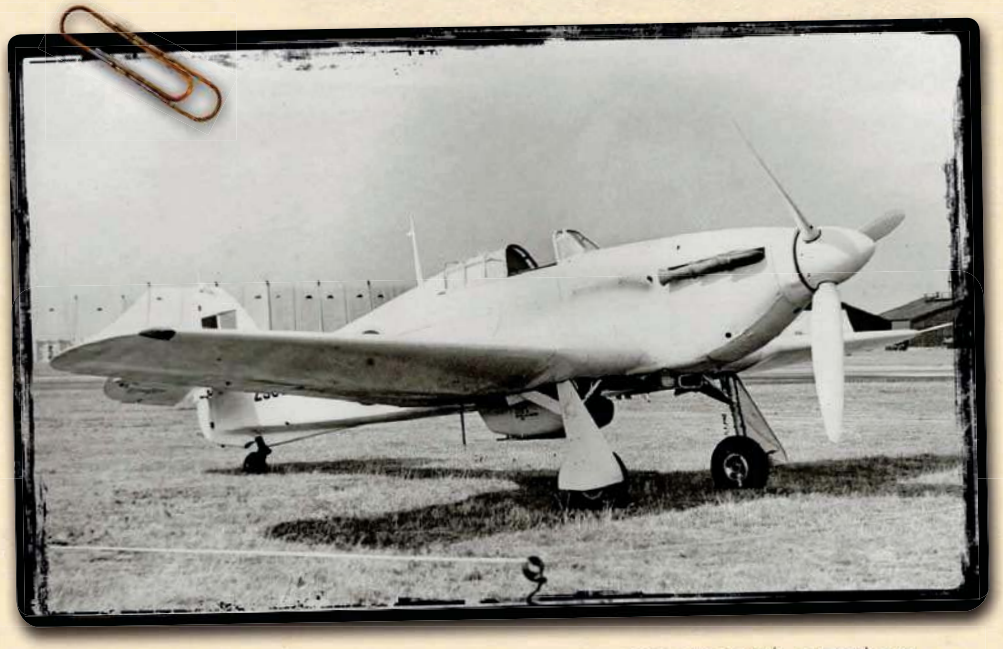
MINISTRY OF SUPPLY

AERONAUTICAL RESEARCH COUNCIL
REPORTS AND MEMORANDA

Going with the Flow?

Britain's contribution to laminar-flow research, 1930–47

The concept of the "laminar-flow wing" is often considered a predominantly American affair, bolstered by the legend of the miraculous P-51 Mustang. However, the British had not only flown laminar-flow wings well before the advent of the Mustang, but had moved on to high-speed shock-reducing aerofoil shapes while aerodynamicists in the USA still grappled with the laminar-flow "unicorn", as **MATT BEARMAN** reveals



LONDON: HIS MAJESTY'S STATIONERY OFFICE

TWO SHILLINGS NET

IN JULY 1944, in a difficult meeting at the Douglas Aircraft Company factory at Santa Monica, California, Edwin P. Hartman, the West Coast co-ordinating officer for the USA's National Advisory Committee for Aeronautics (NACA), was accused by Douglas representatives of costing both the aircraft manufacturer and the nation millions of dollars in a failed experiment.[1] The angry executives demanded to know on what evidence NACA had recommended the application of laminar-flow wings to aircraft (for a glossary of terms see page 77). Such dissent shown to a government body was extremely unusual and showed both the degree to which the industry felt emboldened by its importance to the USA's economy, and the deep anger at what was perceived as a "trick" played upon it.

There was no doubt that NACA had indeed been advocating the laminar-flow concept for years by this time, pointing to the extraordinary performance of North American's P-51 Mustang in the face of mounting evidence that the laminar-flow wing was a "unicorn"; i.e. it was feasible on paper but probably did not exist in the real world, despite many wanting to believe that it did.

Meanwhile, back in the UK . . .

The quietly remarkable Cambridge University-based experimental scientist Bennett (later Sir Bennett) Melvill Jones had been attaching smooth sleeves to the wings of Cambridge University Air Squadron aircraft for ten years by the time of the American industry disquiet above. The conventional history of laminar flow appears to ignore Melvill Jones and, even more remarkably, overlook laminar-flow wings flying in the UK some time before their application to the P-51.

Melvill Jones had already had an enormous impact on what later came to be called, in the USA at least, "the reinvention of the airplane". When Melvill Jones presented his paper *The Streamline Aeroplane* to the Royal Aeronautical Society (RAeS) in 1930, he reduced performance down to a question of drag, before going on to quantify what reductions were possible, down to a minimum attainable figure. He then equated that to the horsepower required to maintain a particular speed. It gave an unusually broad view to an audience of focused specialist engineers, but it was this approach, backed by sound mathematics, that spurred the streamlining revolution on the other side of the Atlantic. In the USA, Francis H. Clauser of Douglas stated that the lecture "led to the practical elimination of unnecessary form drag in modern airplanes".[2]

In the autumn of 1935, 33-year-old NACA scientist Eastman "Jake" Jacobs was returning from the highly influential Fith Volta Conference on high-speed aerodynamics (held by the Royal Academy of Science in Rome), where he had presented a paper showing the first photographs of shockwaves around aerofoils. Described as an "adventurous" scientist, Jacobs keenly accepted an invitation from Melvill Jones to spend some time with him in Cambridge. The latter also arranged for Jacobs to meet famed physicist Geoffrey I. Taylor, whose favourite pastime was punting out to Grantchester. One can picture Jacobs being introduced to cream tea in the Grantchester orchards, the three men settling into deckchairs to discuss high-speed flows while a Hawker Hart with a curious sleeve on its wing burbled back and forth in the blue sky overhead. Taylor went on to join the Manhattan Project.

Melvill Jones, like Jacobs, was a pilot as well as an aerodynamicist, and had pioneered the use of wool tufts on masts glued to wing surfaces to show patterns of airflow. Later he would describe to his nephew the difficulty of "climbing up to the top wing of a double-winged aircraft, with a rope tied round his middle, holding the camera above his head to take photos showing the angle of each of the threads of cotton".[3]

OPPOSITE PAGE ***In 1944 Hawker Hurricane II Z3687 was fitted with Armstrong Whitworth-built outer wing sections for laminar-flow flight experiments.*** **ABOVE** ***Sir Bennett Melvill Jones (1887–1975) in January 1944. Always a keen engineer, Melvill Jones built a two-seat car of his own design, capable of 15 m.p.h. (24km/h), while still at school.***

NASA

LEFT ***Eastman N. "Jake" Jacobs (1902–1987) was the brilliant, if eccentric, American aerodynamicist who began working for NACA at Langley in 1925, quickly pioneering the systematic, mathematical definition of the important series of pre-war NACA aerofoils. After a dazzling, but comparatively short, 19-year career, Jacobs retired from NACA in 1944, moving to Malibu, California, to live on a 73-acre estate with his mother.***

What Melvill Jones was clear on in his conversations with Jacobs was this; where flow was accelerating, the air stayed attached to a smooth wing in flat layers — it was "laminar". As soon as the air stopped accelerating, at the point of minimum pressure (related to the point of maximum thickness), it started to become turbulent — and draggy. This wasn't new, but he had observed it in flight for himself, and that meant everything to the hands-on Jacobs.

Enter the Piercy aerofoil

Norman Augustus Victor Piercy, Professor of Aeronautics at Queen Mary College, London, was an eminent scientist by the time he co-wrote a paper for the *Philosophical Magazine* in September 1937, mathematically describing a "new family of aerofoils" in which the "maximum thickness of the streamline section is as far back as possible, as appears to be generally desirable". It is clear that the idea of laminar flow was not new at this time, and this article is not an attempt to find its "inventor". What Piercy did, however, was describe mathematically the shape of an aerofoil that should theoretically maintain laminar flow while providing lift.

Melvill Jones would have known of the "Piercy aerofoil" when he went to New York in December 1937 to present his latest boundary-layer research at the inaugural Wright Brothers Lecture for the Institute of the Aeronautical Sciences at Columbia University. Repeating it a few days later at the California Institute of Technology (Caltech) in Pasadena in front of aerodynamicists Clark Millikan, Theodore von Kármán, Hall Hibbard, and of course his old friend Jacobs, Melvill Jones showed how minute fluctuations in the wing surface — deliberately placed foil strips or insects and even moisture — caused laminar flow to break down wherever they were placed, whatever the profile of the wing.[4] To a rapt audience — Millikan called it "the most outstanding meeting of the Institute of the Aeronautical Sciences ever held on the Pacific Coast"[5] — Melvill Jones showed graphs of the positions of laminar-flow breakdown experienced during his experiments with Hawker Hart K1442 at Duxford, and also on "a thicker-winged monoplane", almost certainly an Airspeed Courier.

Soon after Jacobs's departure from Cambridge to return to the USA, the Royal Aircraft Establishment (RAE) at Farnborough took delivery in late November 1935 of the sole Miles M.6 Hawcon, K5925, the first of four Miles aircraft (the other three were Falcons) used by the RAE as wing-profile testbeds during 1935–40. In his American lecture in December 1937 Melvill Jones compared his Duxford work with the RAE's experiments with the Hawcon. Comparative graphs showed a difference in the natural break point — when "clean" — between aircraft. Descriptions of any of the aerofoil shapes involved were conspicuous by their absence; the Hawcon experiments were not his and it was not his place to comment on their specifics. Instead, he mentioned that the difference between the best of the results may have been down to shape, and that work was continuing. One can almost picture a "nod and a wink" to Jacobs, before Melvill Jones continued with a mathematical development, touching on manipulation of the pressure gradients of the aerofoils themselves.

The point of Melvill Jones's comparisons between different aerofoils, even if the nature of the aerofoils was left unspecified, would not have been lost on the audience. Melvill Jones concluded by suggesting that whether ongoing experiments "will ultimately reveal the possibility of controlling transition so as still further to reduce drag, or whether it will merely enable the point of transition to be predicted without enabling it to be controlled, is a question which awaits an answer".

Reportedly, Jacobs left his seat at the lecture determined to see how far back transition might be delayed by shape. How much Melvill Jones told Jacobs informally about the work on laminar flow being undertaken at Farnborough, Queen Mary College and the National Physical

The science bit . . . Laminar flow and Reynolds number

*LAMINAR FLOW — fluid flow in which streamlines are invariant and maintain uniform separation, with perfect non-turbulent sliding between layers

The boundary layer — the bit of air that is affected by the movement of the aerofoil up to the point where the air is considered still — exerts friction drag on an aerofoil. Because of the shape of an aerofoil, friction drag is more important than pressure drag. Flow is referred to as "laminar" at the point at which the air essentially slides over the wing in stacked sheets, each moving faster than the next; however, at some point in its passage along the wing this initial state tends to collapse into turbulent flow, which exerts much more friction drag. This change from laminar to turbulent is called boundary-layer transition, and is a normal feature of standard aerofoils. The aim of a laminar-flow aerofoil is to delay that transition.

Boundary-layer separation is a different concept, although this was not universally recognised at the time Eastman Jacobs was working on laminar flow. It is also a "draggy" effect, this time a form of pressure drag and not friction drag. It is the same sort of drag as wing/fuselage "interference" drag (as described in the author's *Tunnel Vision* in *TAH22)*. Boundary-layer separation is also undesirable because it reduces the effectiveness of control surfaces in the detached wake.

Laminar flow is much more prone to separation — this is why some aircraft have "turbulators" and vortex generators to make the boundary layer deliberately turbulent and thus keep it attached.

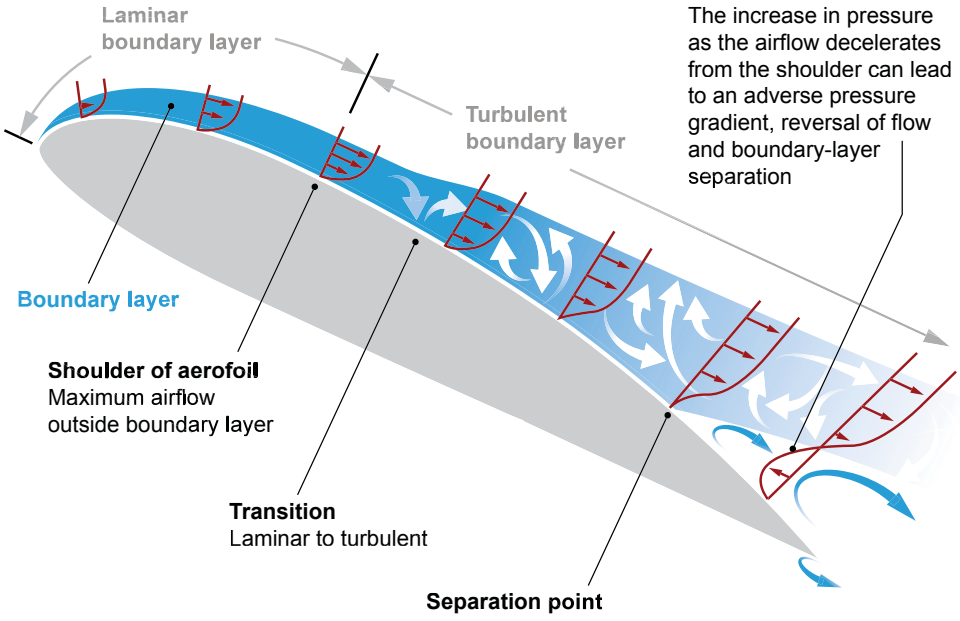


Illustration by IAN BOTT © 2019

*REYNOLDS NUMBER — most important dimensionless coefficient used as indication of scale of fluid flow, and fundamental to all viscous fluids

For all of the confusing definitions that surround it, the Reynolds number is just the chord of the aerofoil times the speed of the aircraft divided by the kinematic viscosity of the air — how fast the air can accelerate out of the way when hit by a fast-moving aerofoil, normally reckoned at being something around 0·000013m/sec². This means that Reynolds numbers for full-size aircraft can be high, 20,000,000 or more, although 20,000,000 *what* is unanswerable, as the units divide out to make the Reynolds number dimensionless.

Essentially, the faster you go, the higher the Reynolds number. An aerofoil, even an example taken from a full-sized aircraft when tested at low speed (as in most 1930s windtunnels), might show laminar flow where at a higher Reynolds number it would be turbulent. This is because the size of dust particle, moisture-droplet or paint-fleck that will trigger a transition reduces directly with increase in Reynolds number. **MATT BEARMAN**

**** Definitions according to* The Cambridge Aerospace Dictionary*, Bill Gunston***

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ABOVE ***The first of the Miles light aircraft supplied to the RAE to be fitted with a "laminar flow" wing was M.3F Falcon Six R4071 (c/n 269). It is seen here sporting the Piercy-type aerofoil (with maximum thickness at 40 per cent chord) with which it was fitted during trials with spoilers (seen extended on the port wing) as a means of roll control.***

Laboratory (NPL) will never be known, but we do know that shortly afterwards Jacobs went on a "walking holiday" that involved some time at the home of American rising-star mathematician Robert T. "Bob" Jones.

Farnborough falconry

In 1939 three new sets of "low-drag" wings for the RAE's Falcons were ordered. Constructed by Phillips & Powis, each set had a partly smoothed, polished wood surface. Based on the theoretical work of Piercy, their profiles had been generated "geometrically", using relatively simple algebra for an intuitively "laminar-flow-friendly" shape, as opposed to being generated "aerodynamically", i.e. from calculations of flow, as Jacobs did later. From a post-war RAE summary it seems that each wing set was applied to a different Falcon. The first interim report on these tests is dated April 1940, and states that "the pressure minima move backwards in sympathy with the maximum thickness, and hence more extensive laminar layers may be attainable. The object of the programme of tests now proceeding is to establish whether it is possible to achieve this in flight".[6]

Delivered to Farnborough on November 30, 1939, M.3F Falcon R4071 sported a 40 per cent aerofoil (i.e. the point of maximum thickness was at 40 per cent of the chord) of Piercy laminar-flow section from at least as early as January 1940, as evidenced by the aerofoil's mention in the RAE's *Flight Tests on a Falcon with Spoiler Lateral Control,* which includes dates of the tests; it is unlikely that the spoilers were test-fitted first and a new wing second. This aircraft was able to retain laminar flow to an average on top and bottom surfaces of about 37 per cent of chord — less than predicted by the theory and reported as "disappointing" in the notes, but still showing some laminar flow.

According to author Peter Amos in his definitive *Miles Aircraft — The Early Years* (Air-Britain, 2009), M.3B Falcon K5924 flew to Phillips & Powis at Woodley to have its laminar-flow wing fitted in late 1939 or early 1940. It is reported as delivered to Farnborough with "test high-speed wings" on March 30, 1940. The April interim report notes an aircraft with a 60 per cent wing as delivered, with "drag tests to begin shortly", and this was probably also K5924.

The 50 per cent wing, with its maximum thickness at mid-chord — technically the NPL EQB (Elliptic Quartic Bezier) 19.7.50/12.5.58[7] — ultimately proved to be the best-performing (i.e. lowest-drag) configuration. This wing was attached to another of the RAE's Falcon testbeds, M.3E L9705, delivered to Farnborough in April 1938. Although there appears to be no record of L9705's activity between March 1939 and December 1940, in 1942 the RAE released a document entitled *Falcon Aircraft L9705 with Wings of Low Drag Section: Maximum Lift Coefficient and Stalling Characteristics*, confirming the identity of the aircraft with the 50 per cent wing. With an aerofoil extremely similar to the USA's later NACA 66-series, a Miles Falcon had achieved laminar flow to 40 per cent of chord by April 1940. Indeed, a footnote gives a hint of the direction — beyond laminar flow — in which the British were now looking: "It is interesting to note that wings with maximum thickness at mid-chord should be the most favourable for postponing the occurrence of the shock stall at high Mach numbers".

A frosty Norwegian and the ice tunnel

From his first mention of designing an aerofoil to encourage laminar flow, Jacobs had been in a bitter dispute with Theodor Theodorsen, head

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ABOVE ***Seen here before its laminar-flow modifications, Miles M.3B Falcon Six Special K5924 (c/n 252) was much used by the RAE as a wing testbed from early 1936. It was re-delivered to Farnborough circa March 1940 with a 60 per cent laminar-flow aerofoil profile (i.e. maximum thickness at 60 per cent of chord) for testing during 1940–41.***

FARNBOROUGH AIR SCIENCES TRUST

ABOVE ***Designed specifically as a research aircraft to investigate the effects of wing thickness on drag, the sole Miles M.6 Hawcon (c/n 187) was given the serial K5925, and arrived at the RAE in Farnborough in late November 1935. The data the tests yielded were of use to Melvill Jones for his boundary-layer lecture in New York in 1937.***

The most effective of the RAE's Miles research aircraft in terms of laminar-flow trials was M.3E Falcon Six L9705 (c/n 289), which, when fitted with an aerofoil with its maximum thickness at 50 per cent of chord (not fitted in this photograph), was capable of maintaining attached "laminar" flow as far back as 66 per cent of chord — if the surface was perfectly smoothed.

PETER AMOS COLLECTION

NASA

ABOVE ***The second XP-51 prototype, 41-039, at Langley in the spring of 1943. Becoming famous as the Mustang, the type was without doubt an extraordinary achievement of both design and engineering. Innovative yet capable of being mass-produced, it was built to far more precise tolerances than were "industry standard" at the time.***

of the Physical Research Division at NACA's Langley facility. The unorthodox approach that Jacobs and Bob Jones came up with in early 1938 was a complete departure from Piercy's concept as well as those of his fellow American designers. He planned to shape aerofoils according to what the most desirable flow-model looked like; he wanted to start with the desired behaviour and shape according to that, rather than draw shapes from geometric rules and narrow down to those with the best laminar behaviour — "control rather than predict", as Melvill Jones put it.

Theodorsen would have none of it. He rejected the mathematics behind Jacobs's model (actually an extension of his own, designed to predict air behaviour over a given shape but "run backwards", as Jacobs put it), referring to it as "nonsensical" and "amateurish". Theodorsen was insistent that the wing surface would need to be a geometrically impossible shape to satisfy Jacobs's equations.[8] It seems that Jacobs's extraordinary drive may in some part have stemmed from a deep desire to prove Theodorsen wrong — which he ultimately did.

Jacobs had been pushing for the creation of a windtunnel of low enough turbulence to test for laminar flow, similar to, but larger than, the very small low-turbulence tunnel in the outbuilding that housed the Aeronautics division of Cambridge University's Engineering Department. It had struck Jacobs that the specifications for such a windtunnel were similar to those of the pressure tunnel already proposed to study ice formation on wings at Langley. Jacobs suddenly became interested in ice formation for long enough to get a tunnel built in the face of Theodorson's antipathy.

Perhaps flushed by this success, and even before the full results of the preliminary tests were in, Jacobs did a curious thing; he wrote a proposal to NACA to apply for a patent on laminar-flow wings designed in this way. It was not pursued, however, as the public organisation had never attempted to raise a patent before.

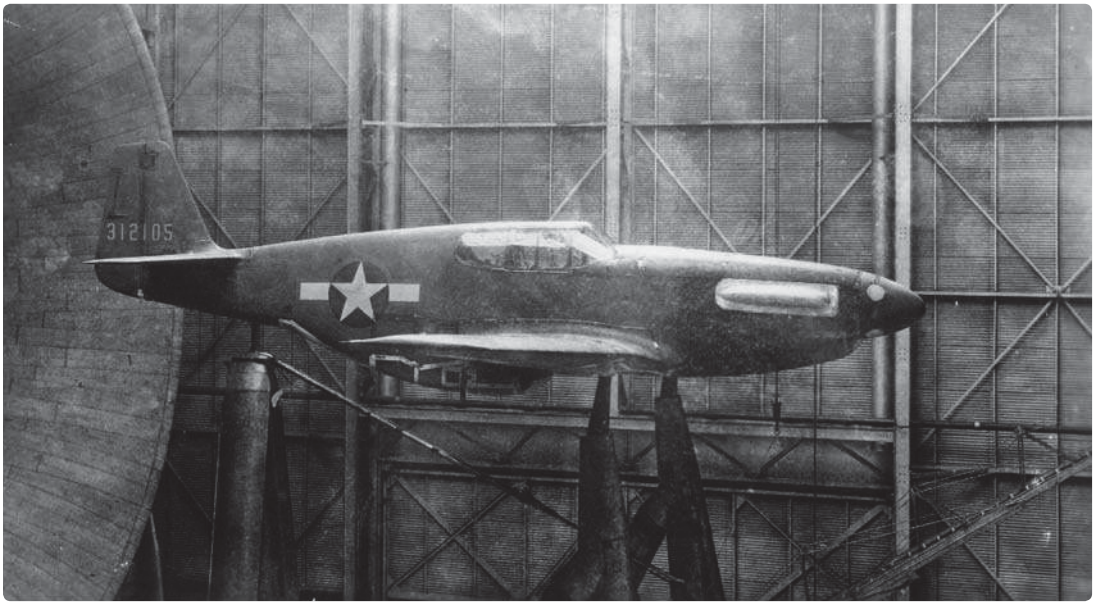
The first runs of the new aerofoils in the ice tunnel gave remarkable results immediately, the report stating that "preliminary experiments in the ice tunnel have more than justified our hopes for low-drag airfoils [sic] through design to produce extensive laminar layers".[9] The recorded 50 per cent reductions in drag seemed a total vindication of Jacobs's single-minded pursuit of laminar flow. Nevertheless, he was keen to underline that this would lower the total drag of an average aeroplane only slightly, where the wing alone was only a small proportion of high-speed drag.

The Mustang gallops in

Jacobs was also clear that current manufacturing standards could not sustain significant laminar flow. He wrote to North American regarding its new fighter prototype:

"NA-73X smoothness — in spite of the fact that your measurements show discontinuities at the rivets and joints of only 0·002in to 0·003in, it is believed that many of the irregularities shown are too large to permit the maintenance of laminar flow over them."[10]

By this time, however, NACA was beginning to feel the need for improved public relations, and once the P-51 (as the NA-73 project became) had shown effortless sparkling performance, the



NASA

ABOVE A *P-51B in the full-scale NACA windtunnel at Langley in 1943. There is surprisingly little contemporary drag data available for the Mustang and almost nothing on the wing. What survives came from German and British sources and indicates that high manufacturing standards rather than laminar flow were the key to the type's success.*

legend — or perhaps more accurately the myth — was encouraged to take root. In *The Wind and Beyond* (NASA History Series, 2003), an excellent forensic review of NACA's aerodynamic achievements, James R. Hansen still allows room for the Mustang/laminar flow legend in his editorial:

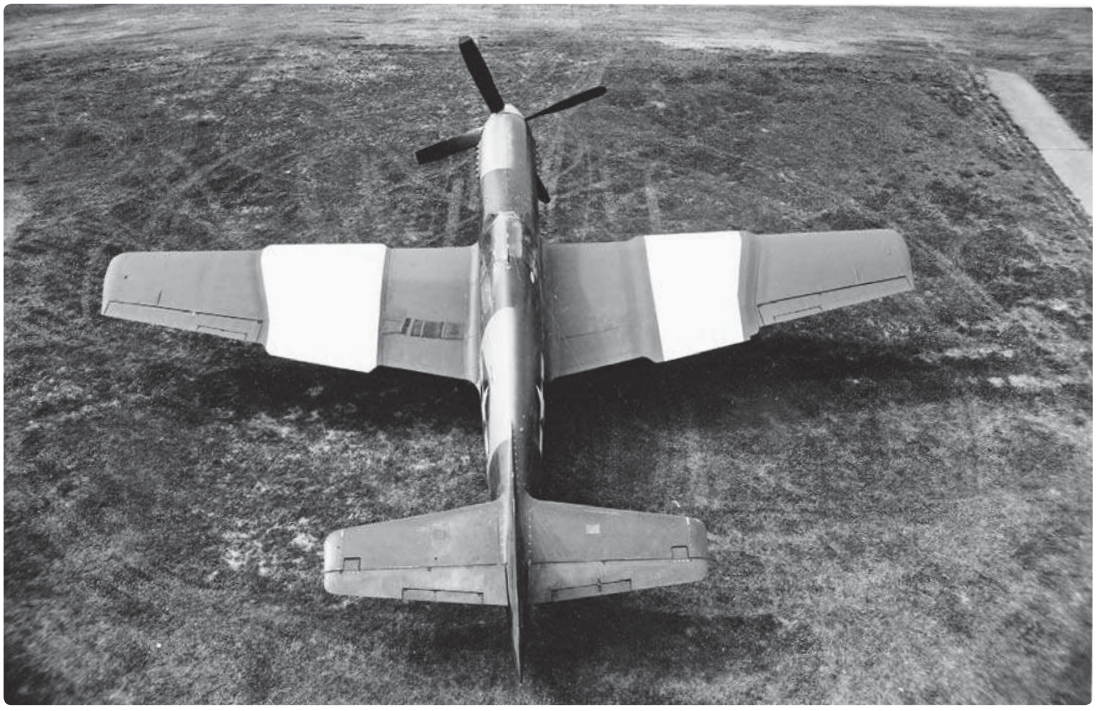
"Considered 'too revolutionary' by many experts at the time, the North American designers grew totally devoted to [the laminar flow concept] — and thus to the NACA research on which it was based. If the laminar-flow wing had proved a mistake, so, too, would have the Mustang. And NACA's reputation for outstanding and reliable research might have been irreparably damaged. But the Mustang flew magnificently, in large part because of its wing."

Public funds had apparently, for once, been justified in a visible way. One aspect of the P-51's aerodynamics seems trivial, but is crucial to the new way of thinking as reflected in Jacobs's "air first, engineering later" approach. Until the advent of the P-51, the shape draughted by designers was generally that of the air inside, around which were wrapped varying thicknesses of metal with approximate curves to fit. The Mustang was the first mass-produced aircraft whose precise outer dimensions were those specified on the drawing board. This also meant production engineers had something to aim at in terms of precise surface shapes. This new way of looking at design promoted extreme accuracy for aerodynamic purposes, although it was a "paradigm shift" with no immediately obvious effect. The "outside-in" approach was later taken a step further by British company Armstrong Whitworth, as we shall see.

At Farnborough laminar-flow work continued, but the emphasis was beginning to shift. The first clouds on the horizon emerged in the second interim report on the Falcon tests. As well as the most promising (50 per cent chord) wing still only achieving laminarity to 40 per cent of chord, "separation of the turbulent boundary layer on the upper surface ahead of the trailing edge [was] observed by means of wool tufts, and, correspondingly, the measured drag was about 20 per cent greater than the drag calculated for the measured transition points".

The key difference here is that between turbulence and separation. It seemed that the more laminar the flow (the less turbulence), the earlier the complete separation and accompanying — potentially even greater — drag. This had been observed by Jacobs in his 1938 comments on Melvill Jones's presentation, Jacobs noting it as a limiting factor to the practical application of laminar flow theory.

Further tests were undertaken at the RAE. Fitting a metal sleeve to a wing improved matters, while a Fairey Battle had "bumps" of a 40 per cent Piercy shape attached to its wings. This provided the RAE with results for higher speeds and thus higher Reynolds numbers (see page 77). Later, sometime between November 1940 and September 1941, one of the Falcons (probably L9705) with a 15 per cent thickness-to-chord-ratio wing at 50 per cent attained laminar flow as far back as 66 per cent at a Reynolds number of $8{\cdot}2 \times 10^6$, although it was "very sensitive to the condition of the surface". The key issue was not so much contamination of the surface as "waviness", an inevitable feature of normal manufacture which could even vary in flight.



NASA

ABOVE ***NACA aerodynamicists were eventually able to study laminar flow over the top surfaces of the Mustang's wing by fitting "sleeves" of the same profile of the type's standard wing, but with an ultra-smooth finish. This continued focus on attaining natural laminar flow contrasted with concurrent British work on bi-convex sections.***

In the summer of 1942 Edward P. Warner, NACA's Chief Physicist and Chairman of its Aerodynamics Committee, travelled to the UK, reporting back the following on August 25:

"In the specific case of the P-51, the performance of which has made a great impression, there is official conviction here that the laminar-flow wing has little to do with the performance. It was first remarked, when I discussed that airplane: 'Well, it really hadn't much of a laminar-flow section'; that was subsequently modified to a suggestion that the wing design was such that laminar flow could only exist near the tips.

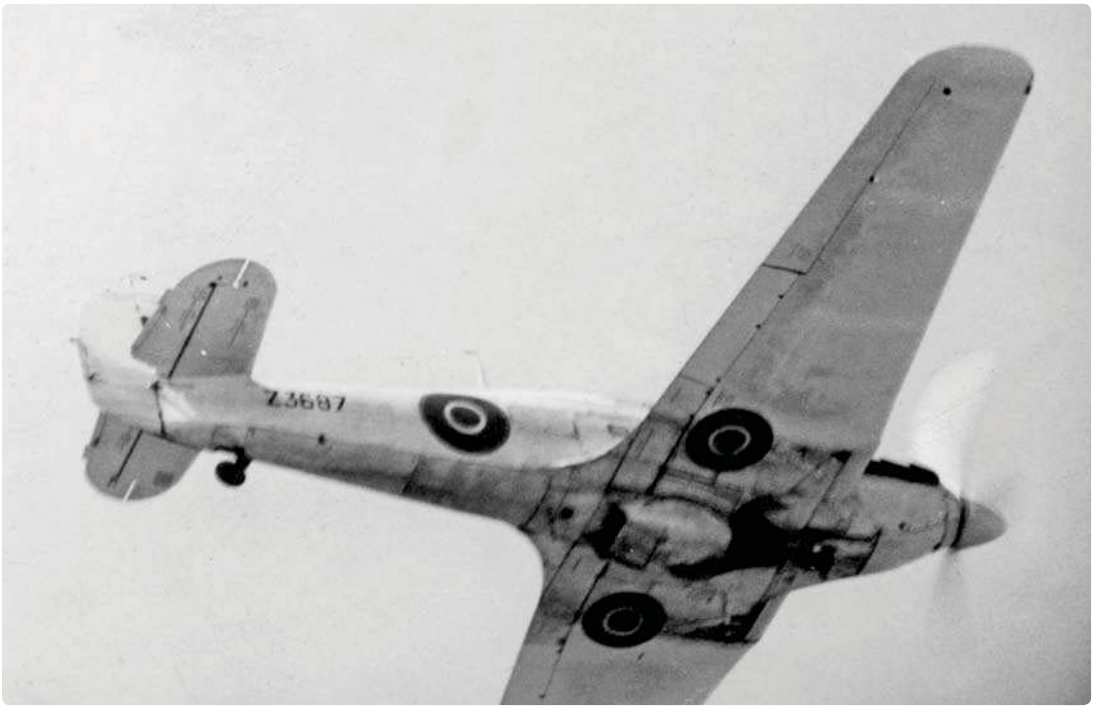
"One expression of the general position of the RAE was that [it] felt relatively little interest in the laminar-flow section as such, but a great deal in compressibility; and that it fortunately happened that the airfoil [sic] form favourable to laminar flow was also one favourable to keeping compressibility to a minimum."

From the outset, the point of the long, slow drop in pressure for the British was as much about avoiding shock as it was about exploring laminar flow. It was accepted early on, thanks to Melvill Jones, that in squadron (or airline) service, wings would never retain laminar flow all the way back to the point where pressure was lowest. Flies, manufacturing wobbles and paint chips would set up turbulent breakaways that would form V-shaped eddies, while panel lines destroyed all chances of laminar flow. Anything in the propwash would not even begin to be laminar. Guns fitted in the leading edge would terminally destroy flow in a 45° trailing wedge.

It was generally known from the 1930s onwards that the same rearward shift of the wing's thickest point, characteristic of laminar-flow aerofoils, was also good for high-relative-Mach applications. Accordingly, two sets of wings were chosen for Gloster's E.28/39 jet technology demonstrator.[11] The "High Lift" set — NACA 230-type as per countless others (even the Auster series) — would guarantee the aircraft got up to speed and height and then provide good data on how a classical wing behaved at controlled high Mach. The alternative "High Speed" set incorporated a Piercy-type aerofoil, developed using geometrical formulæ developed by the NPL into the EC (Elliptic-Cubic) 1240, with the thickest part at 40 per cent, chosen not because of its laminar-flow potential, but because it would not set up a big shockwave at 600 m.p.h. (965km/h). In the June 2008 issue of *The Aeronautical Journal* of the Royal Aeronautical Society, Brian Brinkworth notes:

"By a rearward displacement of the point of maximum thickness, relative to earlier practice, the acceleration of the air over the leading parts of the surface was made more gradual. Contrary to initial expectations, it was now being found that, with suitable profiling, velocities significantly greater than sonic velocity could be reached locally before the first shockwave appeared."

It was estimated by the RAE that the High Speed wing would retain laminar flow at flight Reynolds



PHILIP JARRETT COLLECTION

ABOVE ***Hurricane Z3687 in its initial laminar-flow test configuration, with two Armstrong Whitworth-built wing outer sections. Later trials on a Hurricane with just the starboard wing altered by means of a sleeve have become conflated with this earlier work. Note the underwing roundels relocated to the inner sections of the hybrid wing.***

numbers to around 20 per cent — far less than the "perfect" laminar-flow figure, but laminar flow was not the point of the EC 1240 aerofoil. In fact, although similar, the optimum transonic wing (i.e. one that delays shock) would always be different from the optimum laminar-flow wing (i.e. with a tendency for earlier separation). Early separation and early shock were, as Jacobs had pointed out as early as 1935, related phenomena. *[See the author's* Tunnel Vision *in* TAH22 *— Ed.].*

British jet research gave Jacobs an excuse to recross the Atlantic during 1942–43 on a fact-finding mission, partly because NACA had been kept in the dark about jet engine research while the British were corresponding daily with Lockheed and the USAAF team at Burbank, but also because, as he wrote in an internal memo, he wanted to understand why the British did not appear to be trying too hard to achieve laminar flow. Doubtless when he saw the speeds being predicted he understood more.

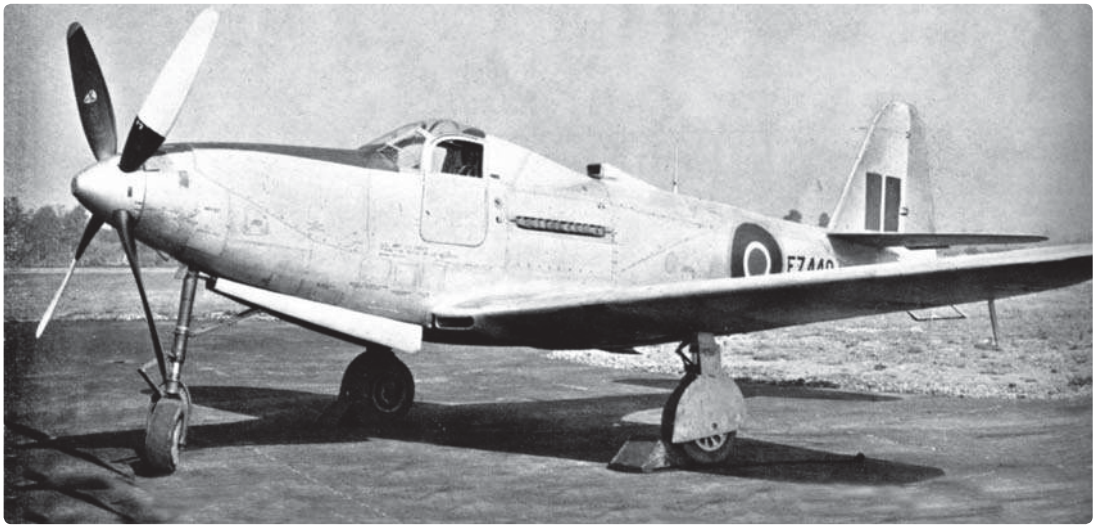
The German perspective

Germany had got hold of a P-51 in early 1943 and immediately began drag testing. At first the wing appeared to exhibit magical properties, prompting comments in the initial (low-speed windtunnel) reports such as: "A comparison of flight measurements [sic] shows quite unmistakably that the Mustang is far superior aerodynamically to all other aircraft". It is also worth mentioning, however, that this came from Theodore von Kármán's translation for NACA.[12]

Whatever the hyperbole, once it was put into the high-speed windtunnel at the *Deutsche Versuchsanstalt für Luftfahrt* (DVL — German Experimental Institute for Aviation) in Berlin, and tested at flight Reynolds numbers, laminar flow just disappeared.[13] At all Reynolds numbers there was a problem with microscopic distortion at the spar line, which guaranteed that flow behind the 25 per cent point was turbulent. At best, only around 5 per cent of the wing surface exhibited laminar flow, and the effect of this on overall performance was negligible. The P-51 wing demonstrated a general superiority to German wing sections tested in the same way — Göttingen University reported a 23 per cent difference in efficiency between the P-51 wing and one removed from a Focke-Wulf Fw 190 — but this was put down to "superior American manufacturing standards".[14]

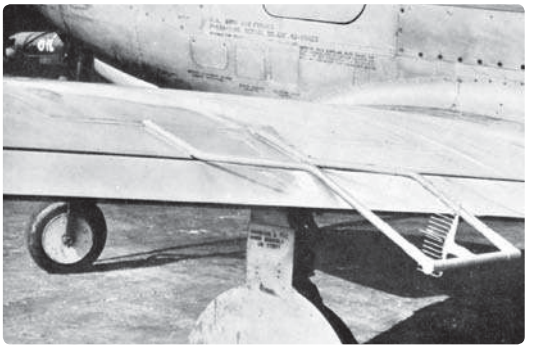
This reflects the view of the British. In August 1943 Ivan Driggs of the US Navy's Bureau of Aeronautics (BuAer) visited England to meet Messrs Goldstein and Relf of the NPL, then engaged in developing high-speed wing sections, along with representatives of British manufacturers. In his report, Driggs stated:

"Invariably the British feel that the P-51 Mustang is a remarkable airplane, but there is no acknowledgment that its superior performance is due to a semi-low-drag wing. Captain Liptrot of the Ministry of Aircraft Production stated that



FARNBOROUGH AIR SCIENCES TRUST x 2

ABOVE ***Bell P-63A Kingcobra FZ440, formerly serialled 42-69423 in USAAF service, was thoroughly wrung out by the RAE during 1945 in trials undertaken to explore the "real-world" behaviour of a laminar-flow wing under various conditions. The type incorporated a low-drag wing profile of NACA design; but, even with a highly polished surface, the profile drag was still deemed "much too high" by the RAE.***



RIGHT ***The standard method of measuring drag during the Kingcobra trials was by means of an array of pitot tubes mounted beyond the trailing edge. Comparison of recorded pressures from the array with a "free air" pitot head indicated total profile drag. Although this did not distinguish friction drag from pressure effects, it nevertheless yielded valuable aerodynamic data.***

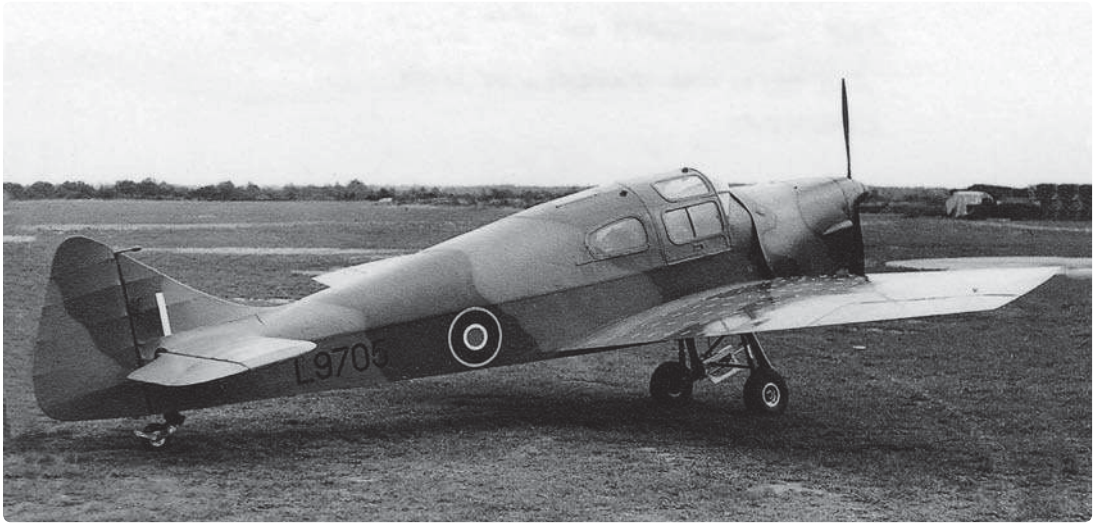
the drag of this airplane, as delivered from the manufacturer, is 50lb [23kg] at 100ft/sec [30·5m/sec], while the Spitfire is about 61lb [28kg] at the same speed, as delivered. He stated that when the latter airplane is faired up with tape over all cracks etc, and the surface put into the same condition as that of the Mustang, the drag is reduced to the same figure of 50lb. It is his belief that the superior performance of the P-51 should be credited to the manufacturing division of North American."[15]

Hurricane and Kingcobra trials

The British did not entirely abandon the laminar-flow idea, however. In early 1944 Armstrong Whitworth Aircraft (AWA) commissioned the NPL to design a laminar-flow wing to fit as outer sections to a Hawker Hurricane II testbed, serial Z3687. The aim was to test the application for AWA's AW.52 flying-wing project, for which laminar flow was always intended. That it was AWA that stepped up to the plate was down to manufacturing skill. The metalworkers at AWA were capable of providing a perfect unbroken skin around an NPL 655-3-218 aerofoil, as fitted to the Hurricane; this was very similar to the NACA 65-220 laminar aerofoil used on the AW.52G half-scale glider, but not the same. It was a test — by AWA — of the engineering, not the theory.[16]

The Hurricane's new wing section (and the whole AW.52 project) was not just designed "outside-in" like the P-51, but was built that way too, with the thick upper and lower skins pre-formed and then joined together with ribs arranged to eliminate "waviness". The result was a surface perfect to better than 0·002in, and it took further smoothing down to 0·001in before the flow stayed attached to 50 per cent of chord, as intended. When wing-drag was eventually reduced by 26 per cent (in the morning, with fewer insects) it was no surprise to the teams at AWA or the RAE when they tested it. However, just as Jacobs would have predicted back in 1939, it made almost no difference to overall performance, as the laminar outer sections were still attached to an otherwise draggy Hurricane.

The RAE at Farnborough continued to try and find a way to apply the technology to the real world, and during the summer of 1945 put hundreds of hours on Bell P-63 Kingcobra serial FZ440, fitted with a NACA laminar-flow section as standard, to assess just how much of the wing was laminar under all kinds of conditions, and why.[17] One experiment included the fitting of a paper cover over the wing's leading edge, which invariably got spattered with insects while the



PETER AMOS COLLECTION

ABOVE ***Falcon L9705 was fitted with another, far more radical, set of wings in 1944, this time intended to test prospective wing profiles for the turbojet-powered Miles M.52. These sharp, thin, bi-convex wing profiles required the undercarriage to be relocated on the "Gillette Falcon", as it was dubbed, and were designed to combat supersonic shock, not explore laminar flow.***

aircraft climbed through the "populated" lower air, and which could then be shed via a "quick release" (i.e. piece of string) once in the clear. The RAE reported that "the device . . . was satisfactory for the smaller section under test but not very suitable for complete wings without a great deal of development". Of course it was not too useful in the rain either.

A new focus

Despite these diversions the focus in the UK was on the ever-increasing effect of supersonic wave drag. The geometric shape of the EC 1240 was designed to delay and reduce shockwave formation; any laminar flow exhibited was purely secondary. Before the war, Italian aerodynamicist Antonio Ferri had been able to test profiles at up to Mach 2·13 in the supersonic windtunnel at Guidonia, Rome, a resource out of reach of British aerodynamicists and a forgotten achievement of Italian engineering.[18] Ferri (who had also been at the Volta Conference in 1935) showed through Schlieren images, like those of Jacobs, that shock formation was much less severe in turbulent non-separating flow; laminar flow made it worse.

At this point, Falcon L9705 re-enters the story. This machine was still putting in hours as a testbed in 1944, and for the sake of science underwent radical surgery one more time in February, when it was fitted with ultra-thin bi-convex sections, as pioneered by Ferri and intended for the Miles M.52 supersonic research aircraft. Designer F.G. Miles intended to ensure that the M.52's low-speed handling characteristics were reasonable, and the bi-convex wing worked surprisingly well; but of course it could not be tested on the Falcon at the speeds it was designed for. This wing was not "laminar flow", contrary to many accounts.

In the USA, attempts to prove that a useful degree of laminar flow could be attained in the real world were continuing apace. The USAAF cut to the chase by putting a laminar-flow wing on a Republic P-47B (making it the sole XP-47F) and recording what happened. It seems that the results were disappointing, and it took a lot of work on the wing to smooth it to the point at which the benefit of laminar flow could eventually be detected.[19] The subsequent report was delivered in the somewhat over-complicated, circumlocutory style NACA adopted for results that did not conform to the desired narrative. It did not contain any direct comparison with the performance, or even the total wing drag, of the stock P-47B. The minimum drag coefficient was attained at 275 m.p.h. (443km/h), after which it went up, although this result is buried deep in a discussion of lift coefficients and wing loading.

Although transition could be delayed to 50 per cent of chord in carefully controlled conditions on a super-smooth unpainted wing, the report's writers stated that the overall drag was "as expected", which is curiously equivocal. It is clear the authors understood that some form of separation was occurring, especially during high-rate turns, and some of the results were even discussed in relation to critical Mach, although they professed to not be able to give "a satisfactory explanation". One can imagine the disquiet in the American aviation industry, which was no doubt familiar with reports of this kind and good at reading between lines.

Laminar flow vs shockwave

In the UK the prototype Supermarine Spiteful had flown in June 1944 with a proprietary Supermarine aerofoil — the 371 — which had been designed in 1942 and was really two aerofoils;

TAH ARCHIVE

ABOVE ***Often described as having a laminar-flow wing, the Supermarine Spiteful was in fact fitted with a hybrid aerofoil, beginning at the root as a shock-reducing shape and blending to a laminar-flow section towards the tip, away from walkways, hatches, cannon barrels and propwash, all of which would trigger significant turbulent flow.***

the 371-I to reduce wave drag at speed inboard where propwash, cannon and walkways would make a laminar shape pointless, and the 371-II for laminar flow outboard.[20] There is no evidence that it achieved the latter, however. While *Flight* referred to the wing as "laminar flow", it went on to define this as "delaying the onset of shockwaves" — the genesis of a confusion that exists to this day.

Meanwhile, the Hawker Tempest's proprietary 1410/375 wing (at tip) may have achieved some retention of a laminar boundary layer as far back as the 37·5 per cent thickest point, but it would only have been a side-effect. "Some degree of laminar flow is expected of [the Tempest wing]" said NACA's Edward Warner in his 1942 report to the USA — and it was certainly kept deliberately smooth — but, he added, "I think the Hawker people expect more gain in performance from the direct effect of a good surface finish, and from the fact that the wing thickness has been reduced by 20 per cent as compared with that of the Typhoon Mk I, than from the change in airfoil [sic] section". The 1410/375 was of elliptic-cubic section, much like that of the E.28/39's High Speed wing.

That the British were moving on from laminar flow was displayed by the choice of a bi-convex aerofoil for the M.52, intended to fly faster than sound. Contrary to accusations of "stolen" technology to break through the "sound barrier" in 1947, Bell's X-1 used a NACA 65 aerofoil, the company still clinging to the desirability of laminar flow in the face of the much more pressing problem of supersonic flight, for which such "incompressible" thinking was irrelevant. There was also some unhelpful disinformation doing the rounds at the time about a form of "drag rise" that was said to be peculiar to bi-convex aerofoils — it was not — before a bi-convex aerofoil was discreetly adopted for the X-2.

The British were not always on the right track either. Despite AWA's best efforts, the full-scale jet-powered AW.52 still could not reliably maintain attached laminar flow, keeping speeds way below those anticipated. It may have been flow separation that excited the flutter that destroyed AW.52 prototype TS363 in May 1949, forcing test pilot J.O. Lancaster to become the first man to use an ejection seat "in anger".

Douglas's ire

When Edwin Hartman of NACA went to that meeting at Santa Monica in July 1944, Dr W. Bailey "Ozzie" Oswald of Douglas put it bluntly: "Millions of dollars have been spent on low-drag-airfoil [sic] applications, which apparently have been unsuccessful, and it is time for something to be done about it". Douglas had clearly had some bad experiences developing the A-26 Invader and BTD-1 Destroyer with NACA laminar-flow wings, although records of these issues have apparently never seen the light of day. An employee at Douglas's El Segundo division added: "There is no definite evidence that the performance of these airplanes is improved by the use of low-drag airfoils or is even as good as if conventional sections had been used".

The one person at NACA who might have listened, being a staunch believer in empirical evidence and knowing from the outset that it took

NASA VIA AUTHOR

ABOVE ***Northrop A-17 serial 35-122 was fitted with large sleeves on each wing for trials with the laminar-flow wing proposed for Douglas's C-74 Globemaster. Each was fitted with two-bladed propellers driven by an auxiliary motor to study the effects of swirling airflow. Douglas blamed NACA for "wasting time" on laminar flow development.***

particular conditions for laminar flow to "work", was Eastman Jacobs — but he had already left NACA under a cloud of his own making, having become increasingly outspoken about the organisation's inability to focus on the problems facing aircraft designers, including those of jet propulsion and supersonic flight. Jacobs went on to have a second career as the proprietor of the Panorama Pacific diner in Malibu — or "Jake's Diner" as it became known in the 1960s, when it became popular with surfers, hippies and actors (and which is still there today as Neptune's Net).

Back in the UK Melvill Jones applied himself to practical problems during the war, heading the team that built the first gyroscopic gunsight. He travelled widely in the USA and Canada during the 1960s, lecturing and renewing old acquaintances — one wonders whether Jacobs ever returned the Grantchester favour and bought Melvill Jones lunch at Jake's Diner . . .

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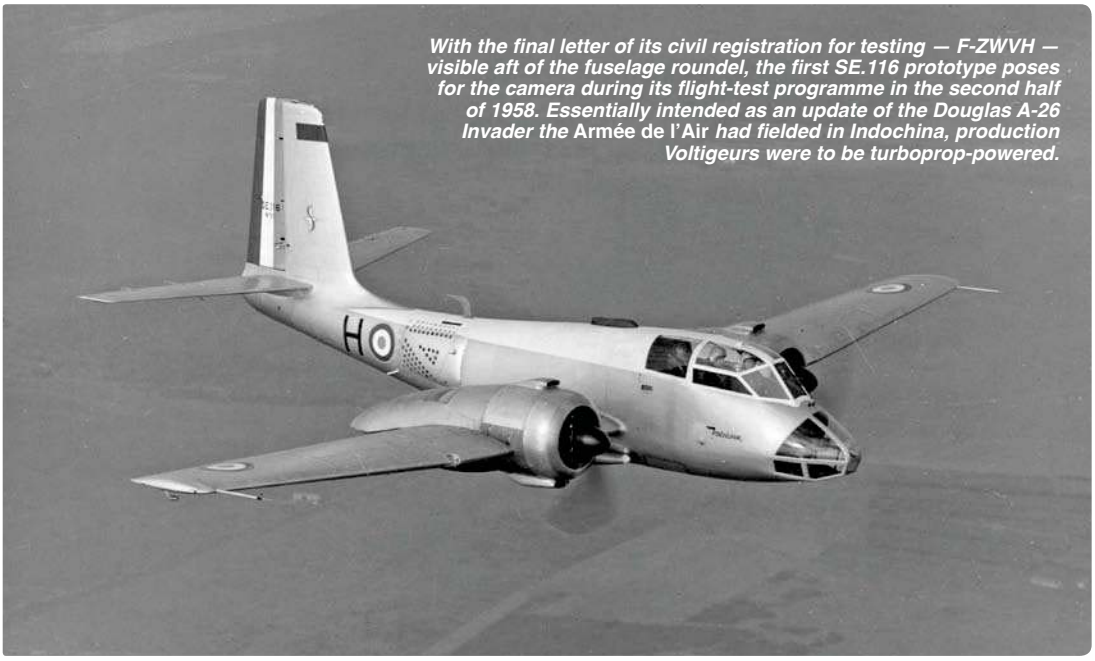
SOLDIER OF MISFORTUNE

THE ILL-FATED SNCASE SE.116/117 VOLTIGEUR

In the mid-1950s France was engaged in a bitter colonial war in Algeria, and soon determined that its air arm was in need of a state-of-the-art ground-attack aircraft to fulfil the vital tactical counter-insurgency role. **JOËL MESNARD** describes the development of the attractive — but ultimately doomed — SNCASE Voltigeur

The first prototype SE.116 Voltigeur, with Wright Cyclone radial engines, displays its warload beside the SNCASE hangar at Marignane in Marseille. France's misdaventures in Indochina — Diên Biên Phu fell in the spring of 1954 — had revealed a need for a modern, effective tactical strike aircraft.



With the final letter of its civil registration for testing — F-ZWVH — visible aft of the fuselage roundel, the first SE.116 prototype poses for the camera during its flight-test programme in the second half of 1958. Essentially intended as an update of the Douglas A-26 Invader the Armée de l'Air had fielded in Indochina, production Voltigeurs were to be turboprop-powered.

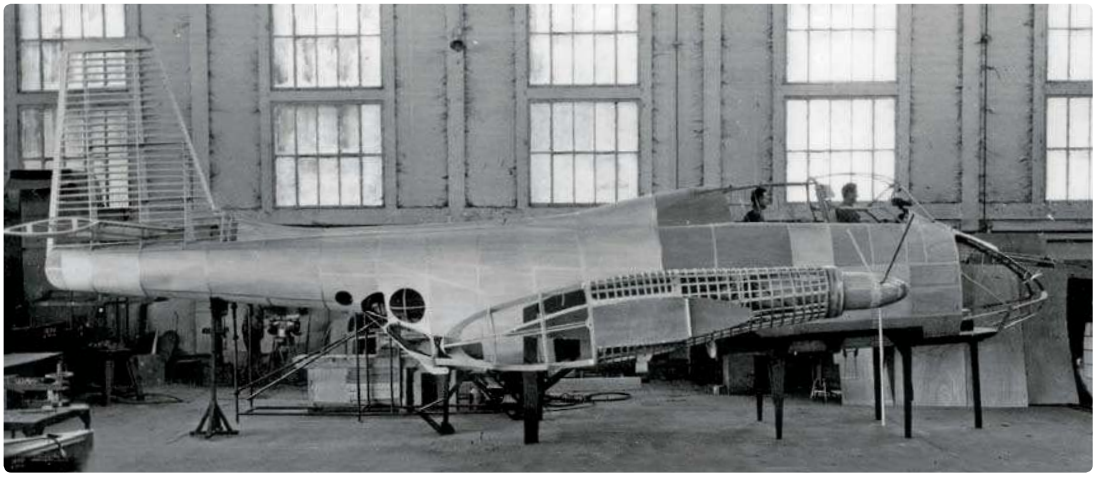
TAH ARCHIVE x 2

VOLTIGE IS THE French word for aerobatics — literally "vaulting" — and originally referred to horseback gymnastics or the work of flying-trapeze artists. However, during Napoleon's campaigns, the name *Voltigeur* was given to elite infantry soldiers who specialised in skirmishing at the arrowhead of the front line. Some 150 years later, the name was given to an ill-fated French twin-engined close-support aircraft.

A NEW INVADER?

Throughout the second half of the 1950s, France's *Armée de l'Air* (AdA) was engaged in a colonial conflict in Algeria in North Africa, for which it was almost entirely ill-equipped. As early as August 1955 AdA headquarters specified a requirement for a ground-support aircraft to be used overseas, which was issued to the *Service Technique de l'Aéronautique* (STAé) and the main aircraft manufacturers. The requirement called for a two- or three-seat aircraft powered by two turboprop engines, to weigh around 4,800kg (10,600lb) and have a cruising speed as low as 220km/h (137 m.p.h.). Ferry-flight range was to be 2,000km (1,250 miles) and the aircraft had to be able to take off from rough fields within 300m (1,000ft). It was to be equipped with two 30mm cannon, and be able to carry a meaningful load of bombs and rockets. Secondary missions for the type would be reconnaissance, medical evacuation and light transport of freight or VIPs.

A total of six manufacturers submitted designs to the Specification: *Société Industrielle pour l'Aviation* (SIPA); *Société Nationale des Constructions Aéronautiques du Nord* (SNCAN);



AUTHOR'S COLLECTION

ABOVE ***The wooden mock-up of the initial SE.116 design, with the rear-facing ventral position aft of the trailing edge, which was ultimately deleted from the finalised design. The contours of the engine nacelle suggest that Turboméca Astazou turboprop engines were also considered as an alternative to the originally intended Bastans.***

Latécoère; Potez; Fouga and *Société Nationale des Constructions Aéronautiques du Sud-Est* (SNCASE). Two of the proposals, those of SIPA and SNCASE, were ultimately selected for development. The two-seat SIPA 1100 was clearly less ambitious than the three-seat SE.116 taking shape in late 1955 and early 1956 on the drawing boards of SNCASE's design bureau headed by Jean Poitou at Marignane, near Marseille.

Initially known as the *Fonceur* (Hustler), the SE.116 was to be powered by a pair of 760 h.p. Turboméca Bastan turboprops. The two 30mm cannon were to be DEFA 552s (a French development of the Mauser MG 213, similar to the British Aden cannon) with 180 shells each. Three hardpoints under each wing allowed for the carriage of 900kg (1,985lb) of bombs and/or rocket-projectiles (RPs). A full-scale wooden mock-up of the SE.116 was built in early 1956, incorporating a rear-facing ventral position. This was ultimately deleted, however, and replaced by an underbelly entry door.

On June 11, 1956, two SE.116 prototypes were ordered. As the Bastan powerplant was still under development, the first machine was to be temporarily fitted with a pair of Wright R-1300-C7BA1 Cyclone 7 radial piston engines, each delivering 800 h.p. This first prototype, now known as the SE.116 No 01 Voltigeur, was ready to perform ground tests at Marignane by mid-October 1957, and the fitted engines were run up for the first time on October 19. Sud Aviation (of which SNCASE became part after its merger with SNCASO on March 15, 1957) performed ground-vibration tests in May 1958.

FIRST FLIGHT

The Voltigeur prototype made its maiden flight on June 5, 1958, with test pilot Roger Carpentier at the controls. As was then common practice with prototypes and development aircraft, only the last letter of its civil registration (F-ZWVH) was painted on both sides of the rear fuselage.

The prototype's first 15 flights quickly revealed

The Wright Cyclone-powered prototype, SE.116-01, lands after a successful test flight in 1958. Design problems with the flap arrangement led to a significant nose-down pitching moment when the flaps were extended, making anything but a three-point landing virtually impossible.

TAH ARCHIVE

TAH ARCHIVE

ABOVE ***The first Voltigeur prototype made its maiden flight on June 5, 1958, in the hands of experienced test pilot Roger Carpentier, officially the first French pilot to have gone supersonic, in a Dassault Mystère II, on December 12, 1952. He also set a new altitude record of 24,300m (79,700ft) in the rocket-powered Trident II in early May 1958.***

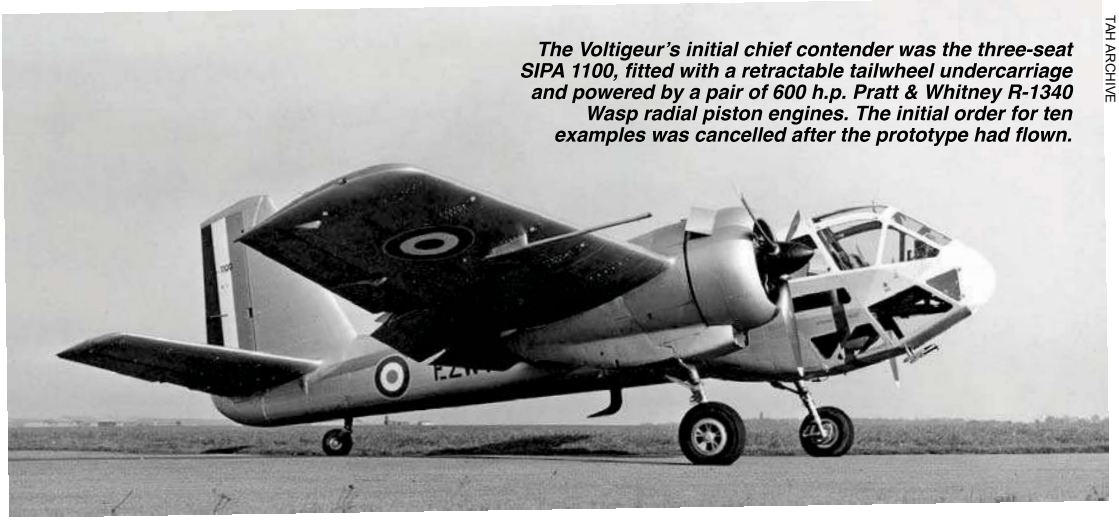
a major flaw; extending the flaps before landing produced a nose-down pitching moment which was difficult for the pilot to counter. Some 6kg (13lb) of force on the stick had to be applied to make a three-point landing. Touching down on just the mainwheels was impossible. These difficulties recalled a tragedy which had happened ten years earlier, on July 20, 1948, when the large four-engined SNCAC NC.211 Cormoran transport prototype attempted to land at Villacoublay after its first flight. A similar tendency to dive when the flaps were lowered had led to catastrophe, when the NC.211 prototype crashed in a near-vertical attitude, killing all five aboard, including test pilot Louis Bertrand.

By the end of June, after 19 flying hours, the SE.116 prototype's tailplane had been reset at an incidence of -1° 30'. It was not enough to produce the necessary effect, however, and the tailplane obviously needed to be enlarged. Nevertheless, test flying continued and the prototype flew 19 more times in July.

Other changes were also made, mostly to the trim tabs of all control surfaces. By the end of August 1958 the prototype had completed 51 landings and accrued 77 hr 25min flying time. By this time pilots and test engineers from the *Centre d'Essais en Vol* (CEV) had flown the Voltigeur, first in June, during the 11th and 12th flights, and again on August 26. Besides the pitch-control problem encountered when the flaps were lowered, the aileron trim tabs also had to be modified. Furthermore, the bulky airbrakes protruding from the Voltigeur's sleek aft fuselage produced drag even when retracted; yet when activated, they proved virtually ineffective. Another type of airbrake would have to be investigated.

ONE-HORSE RACE?

Meanwhile, on April 24, 1958, the SE.116's only competitor, the SIPA 1100, had made its maiden flight. After five weeks of test flying by the manufacturer, it was transferred to Brétigny-sur-Orge for evaluation by the CEV.

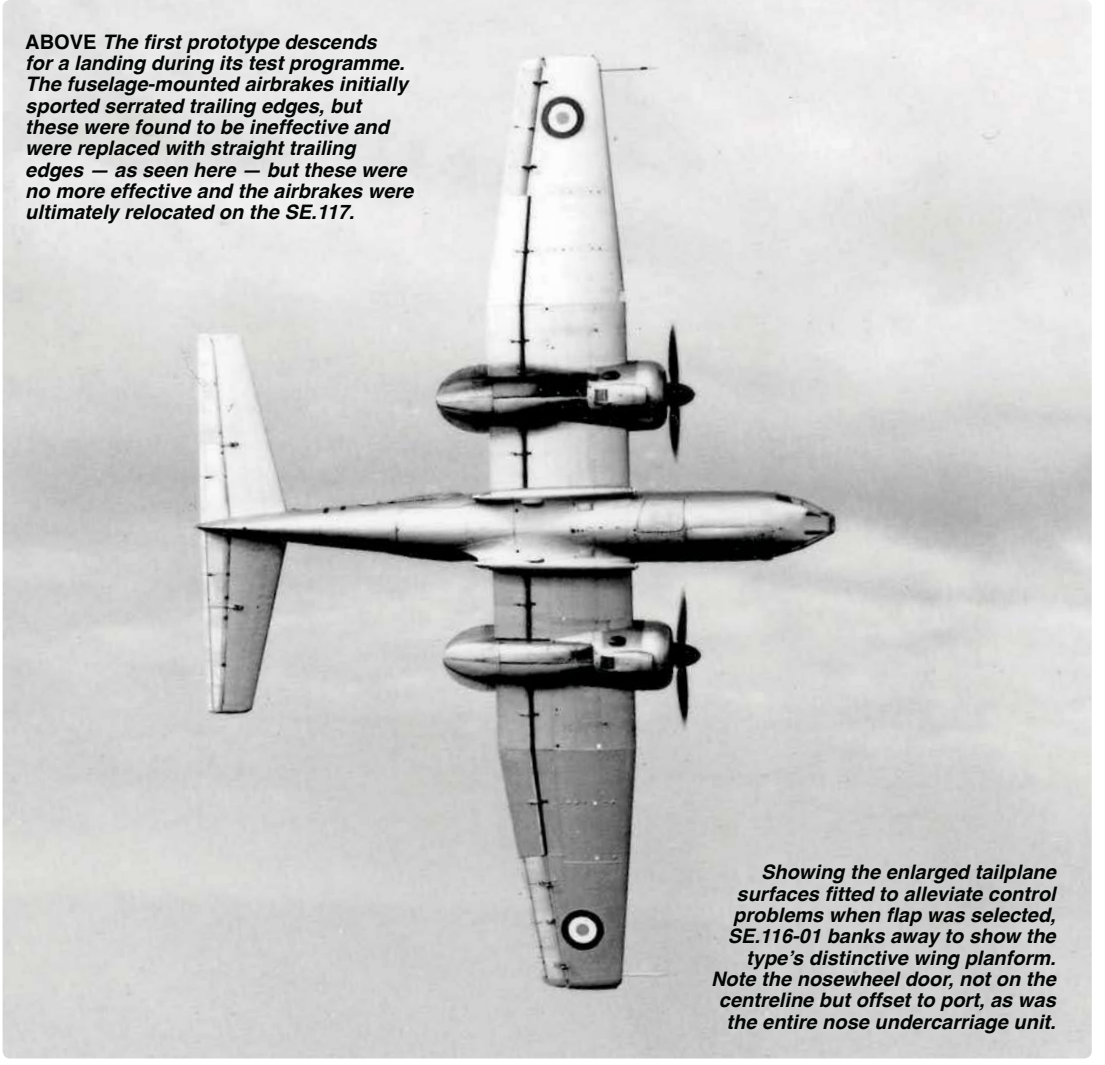


TAH ARCHIVE

The Voltigeur's initial chief contender was the three-seat SIPA 1100, fitted with a retractable tailwheel undercarriage and powered by a pair of 600 h.p. Pratt & Whitney R-1340 Wasp radial piston engines. The initial order for ten examples was cancelled after the prototype had flown.

TAH ARCHIVE

ABOVE ***The first prototype descends for a landing during its test programme. The fuselage-mounted airbrakes initially sported serrated trailing edges, but these were found to be ineffective and were replaced with straight trailing edges — as seen here — but these were no more effective and the airbrakes were ultimately relocated on the SE.117.***



Showing the enlarged tailplane surfaces fitted to alleviate control problems when flap was selected, SE.116-01 banks away to show the type's distinctive wing planform. Note the nosewheel door, not on the centreline but offset to port, as was the entire nose undercarriage unit.

AUTHOR'S COLLECTION

TAH ARCHIVE

ABOVE ***Working to the same requirement as SNCASE with the Voltigeur, Dassault adapted its eight-passenger MD.415 Communauté transport into the MD.410 Spirale for the close-support, operational reconnaissance, liaison and transport roles. The main modification was the military-configured fuselage, with a fully glazed nose section.***

Its overall performance proved disappointing; it was somewhat heavier than expected and underpowered. The engines were not fitted with reduction gearing, and so the small-diameter propellers were rotating so fast that the noise level in the cabin was uncomfortably high.

On July 2 the SIPA 1100 crashed at Villacoublay, killing its two crew members, Pierre Ponthus and André Bouthonnet, during a manœuvrability demonstration at very low altitude. The cause of the crash still remains unclear, but it was suspected that the pilots's seat-fixing to the cabin floor had ruptured while in inverted flight. Two months later, on September 4, a meeting was held by *Général* Max Gelée, the new Chief of Staff of the AdA, during which a decision was made to cancel the SIPA 1100 programme and stop work on the second prototype with immediate effect.

Thus the Voltigeur became the only official entrant in the programme. A new tailplane, of roughly 20 per cent larger span, was fitted to the prototype during the first half of September. To improve safety further, the elevator trim tab was linked to the flaps. While the aircaft was grounded, test firing of the two 30mm cannon was completed at Marignane with the undercarriage retracted. Everything went smoothly, despite a gun-blast problem and smoke entering the cabin.

The Voltigeur was now deemed satisfactory, with good manœuvrability and overall performance, especially on take-off and landing. Ground handling was noted to be easy, needing only the use of the brakes to turn, the steerable nosewheel being considered unnecessary. The second prototype was nearing completion, and its lighter weight, improved fuel consumption and better lateral visibility promised an even better aircraft, completely fulfilling the Specification. Another potential candidate was beginning to emerge, however. Dassault had begun work on a twin-Bastan-powered light transport aircraft incorporating some ground-attack capability, designated the MD.415 Communauté.

The Voltigeur's flight-test programme resumed on October 18, 1958, leading to the deletion of the connection between the elevator tab and the flaps; and the flight controls, mainly the elevator trim-tabs, were also further improved. Flights were also made carrying various underwing stores.

The first prototype was scheduled to be delivered to the CEV on October 26 for its final official evaluation. After completing flight firing tests in Cazaux until November 30, the first Voltigeur would be flown back to Marignane in order to be dismantled. Its wing was to be used to accelerate the completion of a third, more capable, machine. For several reasons, this time schedule was not fulfilled.

A MORE VERSATILE VOLTIGEUR

The engineering team at Marignane, in concert with AdA headquarters, had come to the conclusion that limited design changes could improve the type's capabilities, making it able to fulfil a wider range of missions. Thus a modified Specification, dated August 4, 1958, called for an improved airframe, to be designated SE.117, incorporating a more spacious rear fuselage than that of the SE.116 and other improvements.

The initial design of the SE.116 had allowed for the accommodation of a maximum of seven crew members, four in minimal-comfort conditions. A redesigned wider rear fuselage

continued on page 96

SNCASE/SUD SE.116/117 VOLTIGEUR ILLUSTRATIONS BY JOËL MESNARD

IN TOTAL THREE prototypes of the Voltigeur were built, the first being powered by a pair of Wright Cyclone radial piston engines and the second and third by Turboméca Bastan turboprops. Although broadly similar to the SE.116, the third prototype differed in important aspects, and was accordingly given the new designation SE.117.

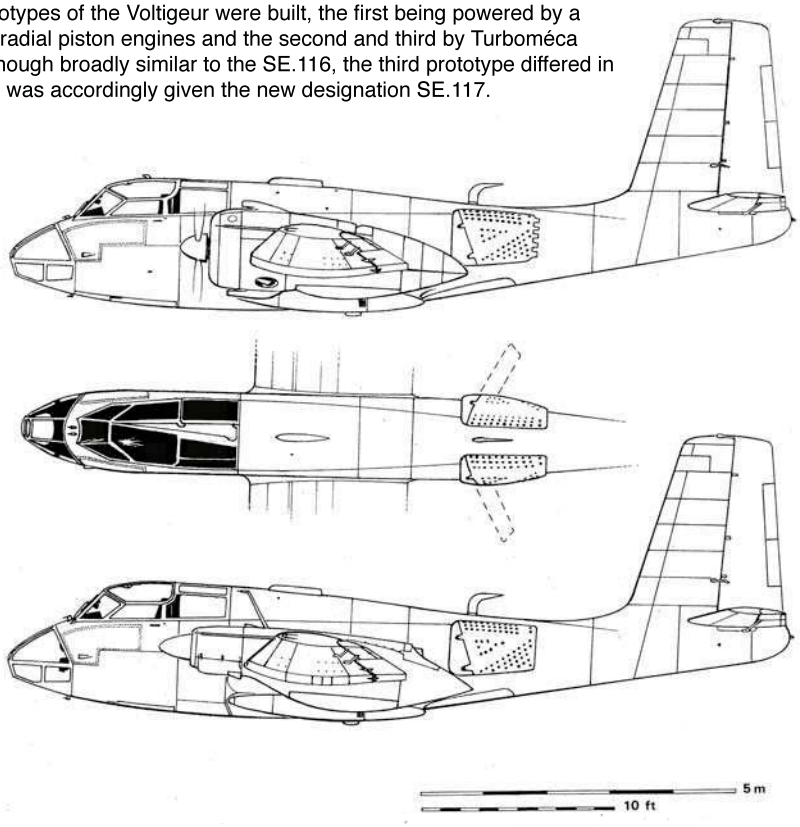
SE.116-01

Note the serrated trailing edge of the airbrake fitted on SE.116-01, an attempt to improve braking efficiency

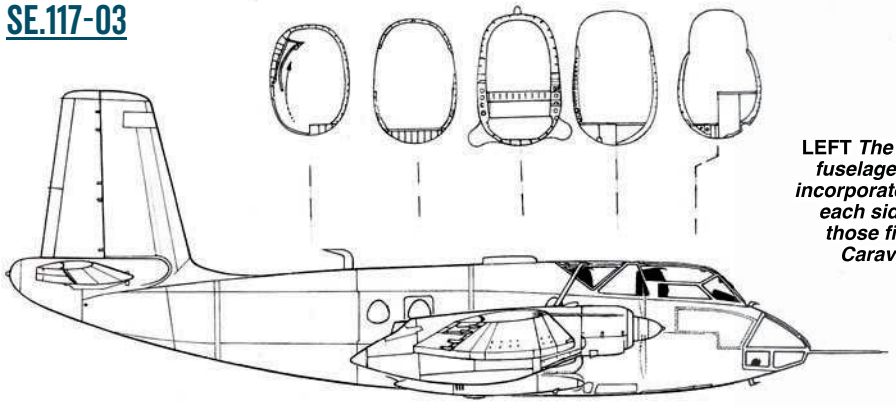
RIGHT ***This topside view shows the asymmetric cockpit configuration as fitted to both SE.116-01 and -02; the broken lines show the airbrake in the open position***

SE.116-02

The second SE.116 prototype incorporated numerous design revisions and was fitted with a pair of Turboméca Bastan turboprop engines in revised nacelles



SE.117-03



LEFT ***The revised deeper fuselage of the SE.117 incorporated two windows each side resembling those fitted to Sud's Caravelle airliner***

SE.117 CONSTRUCTION*

WINGS Cantilever mid-wing monoplane, all-metal construction. Ailerons supplemented by spoilers forward of flaps. Rearward-extending slotted flaps

FUSELAGE Semi-monocoque all-metal structure, with maximum width of 1·32m (4ft 4in)

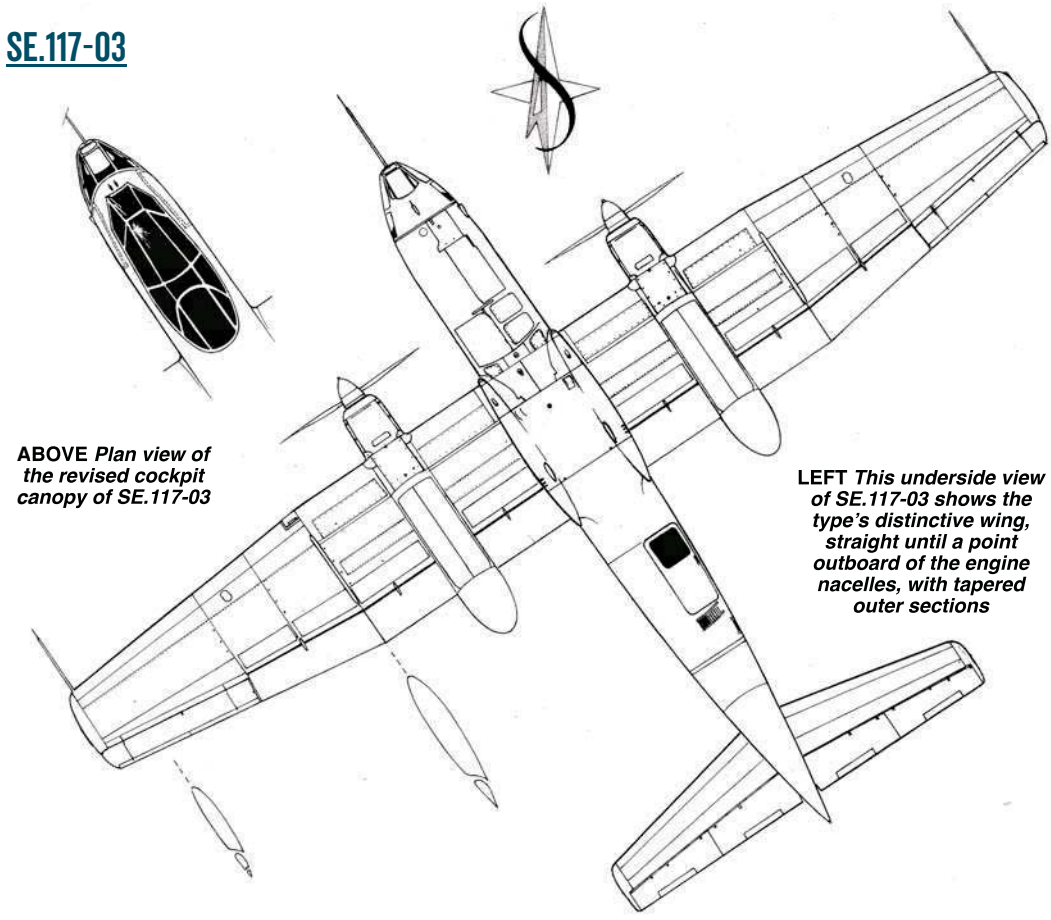
TAIL UNIT Cantilever monoplane type, all-metal construction. Trim tabs in elevators and rudder

UNDERCARRIAGE Retractable tricycle type. Twin wheels on main units. Tyre pressure 2·2kg/cm² (31lb/in²). Wheel track 5m (16ft 5in)

ACCOMMODATION Crew of two or three, comprising pilot, navigator and weapons operator; also provision for five passengers or two stretcher cases

*Source: *Jane's All The World's Aircraft, 1959–60*

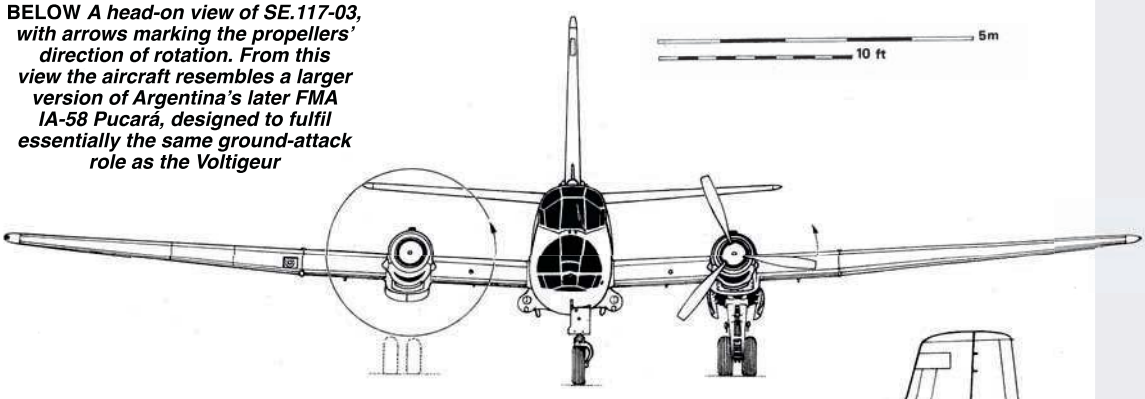
SE.117-03



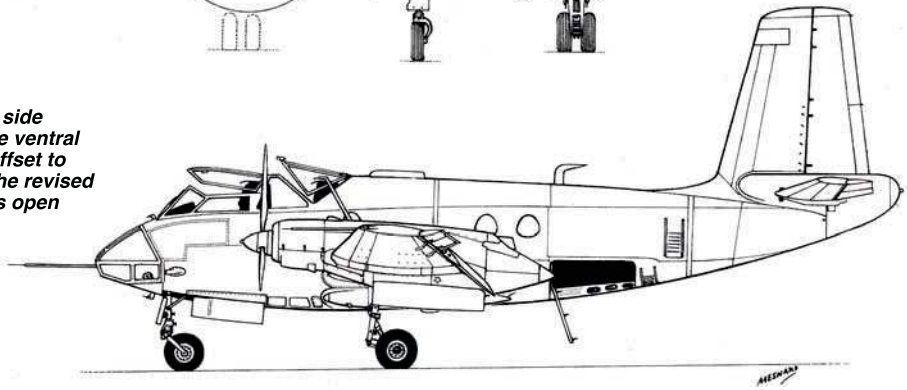
ABOVE *Plan view of the revised cockpit canopy of SE.117-03*

LEFT *This underside view of SE.117-03 shows the type's distinctive wing, straight until a point outboard of the engine nacelles, with tapered outer sections*

BELOW *A head-on view of SE.117-03, with arrows marking the propellers' direction of rotation. From this view the aircraft resembles a larger version of Argentina's later FMA IA-58 Pucará, designed to fulfil essentially the same ground-attack role as the Voltigeur*



RIGHT *This port side profile shows the ventral entrance door, offset to port, open and the revised cockpit canopies open*



AUTHOR'S COLLECTION

ABOVE ***A comparatively rare photograph of the second Voltigeur, bearing the last letter of its civil registration, F-ZWVI, on its aft fuselage, and fitted with Bastan turboprops. Its career was short: it made its maiden flight on December 15, 1958, but crashed as a result of extreme flutter a mere 25 days later, killing all three crew aboard.***

continued from page 93

could accommodate eight crew members, four of which would be seated more comfortably. Fuel tanks in the fuselage could be relocated in the wings. A ventral entry door, offset to port, sliding upwards inside the fuselage, would allow for the parachuting of small loads. The inefficient rear-fuselage airbrakes could be replaced by panels in the wings. The underbelly twin gunpack would remain unchanged, as would the forward section of the fuselage and the excellent undercarriage. In case the Bastan turboprops proved unsatisfactory, the new design could retain the Wright Cyclones.

This improved Voltigeur would meet a wide range of AdA needs. It could be used as a liaison/light transport aircraft or a flying classroom for transport pilots and navigators, as well as many other roles, incuding medical evacuation, rescue, aerial photography or as an airborne command post. Thus, the definitive Voltigeur gradually took shape on the drawing boards.

Other developments were also considered. Dated September 25, 1958, a STAé document mentions two light-transport derivatives, including the SE.118 Diplomate, intended to fulfil a Specification dated November 12, 1957, for a liaison aircraft with a pressurised fuselage, and to which Sud had built two full-scale mockups by early 1958. The AdA headquarters considered this project too different from the SE.116 to provide a substantial cost saving, however, and the manufacturer altered its proposal to create the SE.119, with a less bulky fuselage, a glazed nose section and the ability to carry the twin 30mm cannon pack of the SE.116/117. Neither of these transport variants ever came to fruition.

On December 15, 1958, the turboprop-powered second Voltigeur prototype, F-ZWVI, made its maiden flight, again with Roger Carpentier at the controls, along with flight-test mechanic Marcel Hochet. Général Edmond Jouhaud, Chief of Staff for the AdA, was present and was impressed by Carpentier's nimble low-altitude demonstration. The Voltigeur was — somewhat prematurely — considered the winner of the programme.

The second prototype accrued 9hr 35min flying time during its first six flights, achieving a maximum diving speed of 383km/h (238 m.p.h.) and a load factor of 5·2 (i.e. the total load on the aircraft's structure was 5·2 times its gross weight), while weighing in at 5,420kg (11,950lb).

TRAGEDY STRIKES

On January 9, 1959, the second Voltigeur prototype took off for its seventh flight. Along with Carpentier were flight-test engineer Yves Crouzet and Marcel Hochet. Suddenly, at 1547hr, all radio contact was lost. The second Voltigeur had crashed at Eyguières, killing the three crew members. The next day, farmer Etienne Crespo discovered a large piece of metal in his field in Salon-de-Provence. The ensuing inquiry pointed to a mechanical failure resulting from flutter. The Voltigeur's control surfaces had been consistently problematic and had been modified several times. On November 3, 1958, a balance weight on the starboard elevator of SE.116-01 had broken off after a 4g load had been applied. The control surfaces and tabs on the second prototype were different again. Significantly, no aeroelasticity tests had been undertaken.

As a result of the crash, flight gunnery tests

TAH ARCHIVE

ABOVE ***The third and final Voltigeur prototype, F-ZWVX, incorporated sufficient design changes to merit a new designation, SE.117, although the prototype sequence was maintained as No 03. Despite the changes, the type still experienced control problems during its test programme and was ultimately used mainly as a Bastan testbed.***

with the first prototype were cancelled and it never flew again. It had logged 73 flights and was used for further ground-based cannon-firing trials. By request of the inquiry commission, its radial engines were exchanged for Bastans and it was modified to become as similar as possible to the second prototype. During May 10–23, 1959, it was submitted to vibration tests by a team of specialists from the *Office National d'Etudes et de Recherches Aéronautiques* (ONERA). Vibration nodes were discovered on all control surfaces at frequencies between 20Hz–40Hz. Outer balance weights were the cause of most of these vibration nodes, and spring tabs were suspected to be another cause. The ONERA team decided that further vibration tests of the ailerons were necessary, and these were performed at the *Etablissement Aéronautique de Toulouse* (EAT) from December 1959 to May 1960.

THE LAST-CHANCE VOLTIGEUR

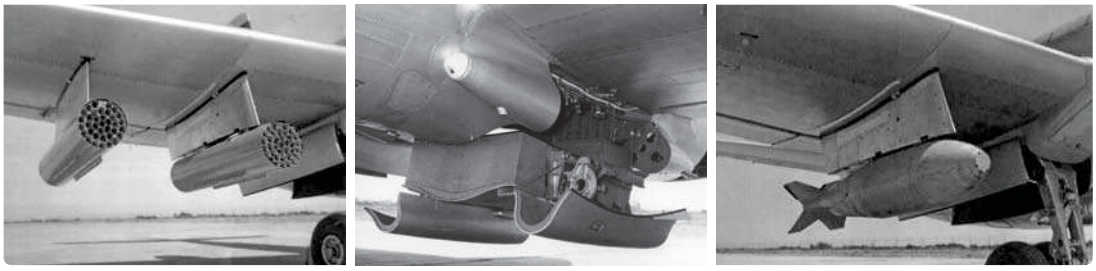
For more than a year no Voltigeur was seen in the blue skies above Marseille. Nevertheless, 1959 was still a busy year at Marignane, as work progressed on the SE.117. Although the plan view remained virtually unchanged, the lower part of the wing and that of the whole tailplane was made of AU4G1 aluminium instead of AZ5GU. In addition, the aileron spring tabs were replaced with automatic tabs and all flying controls were no longer actuated by cables and pulleys, but by solid rods. The leading edge of the inner wing section, inboard of the engines, was slightly cambered, in order to cure buffeting at near-stall conditions. The incidence of the tailplane was made manually adjustable and the undercarriage was strengthened to allow take-off weights of up to 6,754kg (14,890lb). Six Caravelle-style portholes provided light in the central part of the fuselage.

As a result of the loss of SE.116-02, it was decided to equip the third prototype with ejection seats. Two Martin-Baker units delivered to Sud for use on its Trident II pre-series aircraft were available, the latter programme having been abandoned at the end of April 1958. Their use on SE.117-03 necessitated a redesign of the cockpit canopy, which became symmetrical, with a sloping (instead of vertical) aft end. Vibration tests led to further adjustments of the ailerons and elevator controls.

The third Voltigeur, SE.117 F-ZWVX (marked X), made its first flight on January 21, 1960, with pilot Petit at the controls. By mid-March, it had flown 31 times. Pierre Nadot, chief test pilot at Sud Aviation, estimated that the most urgent task was to improve lateral and directional controls. He stressed that a dorsal fin should be added.

The now sole flying Voltigeur was used extensively in the development of the Bastan turboprop, which was also undergoing testing on a Bloch 161 Languedoc, a modified Beech 18 and a Morane-Saulnier MS.1500 Epervier. Three notable incidents occurred, fortunately without serious consequences. On April 9, 1960, during flight No 34, the turbine inlet temperature on one engine rose alarmingly, the same happening again during a ground engine run after flight No 37. During flight No 51 the port Bastan lost power while its temperature increased, and as a result had to be replaced. On April 30 F-ZWVX was transferred to the CEV at Istres for evaluation, although three problems remained to be solved.

TAH ARCHIVE



AUTHOR'S COLLECTION x 3

TOP ***The incorporation of a deeper and wider rear fuselage robbed the SE.117 of the previous prototypes' more elegant profile, but it could carry a crew of eight in greater comfort.*** **ABOVE** ***A sequence of photographs showing the SE.117's ground-attack ordnance capability. From left: a pair of rocket-launchers on two of the starboard wing's hardpoints; extended belly-mounted 30mm cannon bay (minus guns, looking aft); general-purpose bomb.***

First, the ailerons were too heavy and not considered sufficiently effective. Four solutions were considered: the addition of spoilers; the fitting of ailerons with spring tabs, as on SE.116-01; the replacement of the control column with a yoke, and the fitting of servo-controls. Secondly, low-speed flying with one engine out called for prohibitively high loads on the rudder pedals. For this, five solutions were proposed: increasing the fin and rudder surfaces; modifying the rudder balance-weight; replacing the automatic tab with a spring tab; the fitting of a reliable prop-feathering system, and a servo-control. Finally, it was felt that the pilot was insufficiently warned when he was approaching stall conditions with the flaps down between 20° and 40°.

On May 18 the prototype flew back from Istres to Marignane, for improvements to be made to the flight controls and the incorporation of wing spoilers. During June 2–22, 1960, it was again under CEV control for a new series of evaluations.

A FORCED WEDDING

The second half of the 1950s in France had been a period of financial constraints, for the aircraft industry as well as operational air units. Many state-of-the-art aircraft designs — SNCASO's Trident II and III, Sud's Super Vautour, SNCASE's Durandal, Nord's Gerfaut II and Griffon II, for example — were to fall victim to this shortage of funds, which stemmed from the need to fight a costly war in North Africa.

As early as September 25, 1958, in a report on the progress of the Voltigeur programme, the STAé had noted that Dassault was working on a similar project, the MD.415 Communauté, which had been designed as a light transport aircraft, but with an auxiliary ground-attack capability. The SE.117 was similar but designed the other way around, and it was justifiably considered to be uneconomical to develop both types simultaneously, although the Communauté was being developed as a private venture.

In December the *Ministre des Armées* (Defence Minister), Pierre Guillaumat, announced that the SE.117 Voltigeur and SE.118 Diplomate had been chosen for mass production. Then in January 1959 disaster struck as related above, and the Voltigeur would not fly again until the third prototype made its first flight a year later. On May 10, 1959, the MD.415 made its first flight, and seemed well placed to steal the contract from the

Voltigeur. Furthermore, Dassault had announced a military variant of the MD.415, designated the MD.410 Spirale, optimised as a close-support aircraft, with liaison as a secondary role. The Spirale first flew on April 8, 1960, just two-and-a-half months after the SE.117, using the wings of the Communauté prototype, which had logged some 158 flying hours over 137 flights — far more than the cumulative total of the Voltigeurs — emphasising the high degree of commonality between the Communauté and Spirale. The third Voltigeur was now to be developed jointly by Sud and Dassault, and its fin sported the names of both manufacturers.

By this point, however, President Charles de Gaulle's policy was changing. The priority was no longer to win the war in Algeria, but to promote self-determination for the country instead. At the same time, he favoured a policy of independence from the USA and Nato, the result being the creation of a French nuclear deterrent, known as the *Force de frappe* (Strike Force) or *Force de dissuasion* (Deterrent Force). This would leave little money for more conventional aircraft.

Flight testing of the Spirale quickly proved satisfactory, and it was delivered to the CEV at Istres on May 3, 1960, a few days after the SE.117. A joint report by the CEV and the *Centre d'Expériences Aériennes Militaires* (CEAM) concluded that comparative tests clearly favoured the Dassault design — but the overseas ground-attack support and light-transport aircraft programme was abandoned in the summer of 1960.

With no mission to perform, the sole SE.117 was relegated to become a flying testbed for the Bastan turboprop, and was delivered to the *Compagnie Générale des Turbo-Machines* (CGTM). It performed this task until it was finally retired on February 27, 1962. Sadly, the Voltigeur went from being a cutting-edge modern ground-attack aircraft at its inception to a disabled, engineless carcase on a forgotten part of Istres airfield.

SNCASE/SUD SE.116/117 VOLTIGEUR DATA COMPILED BY JOËL MESNARD

	SE.116-01	SE.116-02	SE.117-03
Powerplant	2 x 800 h.p. Wright R-1300-C7BA1 radial piston engines	2 x 650 e.h.p. Turboméca Bastan turboprop engines	2 x 750 e.h.p. Turboméca Bastan turboprop engines
Dimensions			
Span	17·97m (58ft 11½in)	17·97m (58ft 11in)	18·01m (59ft ⅔in)
Length	12·35m (40ft 6in)	12·35m (40ft 6in)	12·61m (41ft 4½in)
Height on ground	5·71m (18ft 9in)	5·71m (18ft 9in)	—
Wing area	41·7m² (449ft²)	41·7m² (449ft²)	—
Max fuselage width	1·32m (4ft 4in)	1·32m (4ft 4in)	1·32m (4ft 4in)
Wheel track	5·0m (16ft 5in)	5·0m (16ft 5in)	—
Weights			
Empty	4,200kg (9,260lb)	—	5,860kg (12,920lb)
Loaded, minus external stores	5,635kg (12,425lb)	—	—
Loaded, with external stores	6,520kg (14,375lb)	—	—
Max take-off	—	—	6,754kg (14,890lb)
Performance			
Maximum speed	380km/h (236 m.p.h.)	—	455km/h (285 m.p.h.) at 3,500m (11,500ft)
Stalling speed	115km/h (71 m.p.h.)	—	165km/h (102 m.p.h.) at 5,220kg (11,508lb)
Cruising speed	315km/h (195 m.p.h.)	—	—
Take-off run	350m (1,150ft)	—	200–290m (660–950ft)
Landing run	350m (1,150ft)	—	200m (660ft)
Initial climb	—	—	750m/min (2,460ft/min) at 5,220kg (11,508lb)
Time to 3,050m (10,000ft)	6min 35sec	—	—
Endurance	—	—	7hr
Ceiling on one engine	—	—	5,000m (16,400ft)

Armament 2 x DEFA 522 30mm cannon with 150 rounds per gun mounted externally on fuselage under wing roots + variety of ordnance on six wing-mounted hardpoints

SUBJ CONTAINER SHIP SS MAYAGUEZ

MSN NO. SPECIAL USN P-3 UTM UNK

MSN DATE 13 MAY 75 FRM 0003 OBLIQUE

THE MAYAGUEZ INCIDENT

F-4 Phantoms of the 432nd TRW in Thailand, 1975

When Khmer Rouge forces seized the civil container ship *SS Mayaguez* off the coast of Cambodia in May 1975, the American war machine swung back into action, despite its recent withdrawal from the conflict in neighbouring Vietnam. **BILL CAHILL** details the role of the F-4s of the USAF's 432nd Tactical Reconnaissance Wing during the incident

PRODUCED BY 432 RTS 14 MAY 75

OPPOSITE PAGE AUTHOR'S COLLECTION / THIS PAGE VIA WARREN THOMPSON

ALTHOUGH THE WAR in South-east Asia was officially over, it had been a busy few months for the USAF's 432nd Tactical Reconnaissance Wing (TRW). In late March 1975 the 432nd had been directed to support Operation *Eagle Pull*, the evacuation of American personnel and dependants from Phnom Penh, the capital of Cambodia. Three of the Wing's five squadrons flew missions covering the April 12 evacuation, with the other two squadrons at readiness. Two weeks later, the 432nd was at it again for Operation *Frequent Wind*, the evacuation of American personnel from Saigon. The Wing launched 68 sorties, with four squadrons providing cover for US Marine Corps (USMC) and USAF helicopters flying "evac" missions.

Just when the Wing was getting its crews and aircraft back into a training rhythm, another crisis was dropped on its doorstep; the American merchant vessel *SS Mayaguez* had been seized on May 13 by Cambodian Khmer Rouge revolutionaries, and the US Seventh Air Force required the now-missing vessel to be found.

Genesis

The 432nd TRW had been formed in September 1966 from the 6234th Tactical Fighter Wing (TFW) at Royal Thai Air Force Base (RTAFB) Udorn in Thailand as a McDonnell Douglas RF-4C Phantom II Wing. Squadrons were added and subtracted to its structure but by early 1975 the Wing consisted of four F-4 squadrons and one RF-4C squadron, each assigned 24 Phantoms.

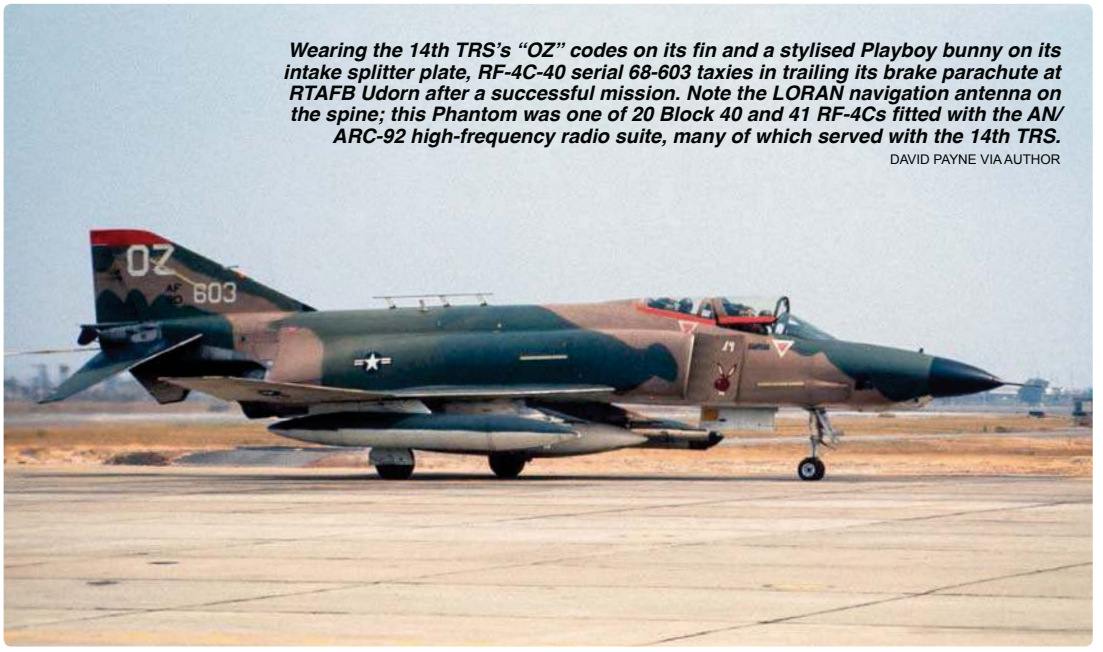
Two of the F-4 squadrons — the F-4E-equipped 421st Tactical Fighter Sqn (TFS) and 25th TFS — focused their training on the air-to-air mission, while the 4th TFS and 13th TFS, equipped with a mixture of F-4Ds and F-4Es, concentrated on the ground-attack role, including laser-guided bomb operations. The 14th Tactical Reconnaissance Sqn (TRS) rounded out the wing and was the only RF-4 photo-recce variant unit in theatre.

Captain John Zink was a newly minted pilot assigned to the 13th TFS, known as "The Panthers". Fresh from F-4 conversion training in May 1974, Zink flew as a wingman in the Panthers, in which the majority of the squadron had completed one, if not two, previous tours in South-east Asia. Although things had quietened down by the time Zink arrived, the base was still close to potential action. John's first combat sortie was flying cover for *Frequent Wind*.

Lieutenant Jim Bortz, a Weapons Systems Officer (WSO) in the 14th TRS, had arrived in early 1975, but had already flown combat missions owing to the nature of his work. As it was for Zink, this was Bortz's first operational assignment following F-4 conversion training. After completing his six-month checkout, he took leave before arriving in Thailand.

Although the USA was no longer involved

OPPOSITE PAGE ***The* Mayaguez *was seized by Khmer Rouge soldiers on the afternoon of May 12, 1975, and the following morning US Navy Lockheed P-3 Orions were sent to locate and photograph the vessel.* ABOVE *An F-4E of the 432nd TRW's 421st TFS with shark's mouth — to spit deadly fire from its M61 nose-mounted six-barrel cannon.***



Wearing the 14th TRS's "OZ" codes on its fin and a stylised Playboy bunny on its intake splitter plate, RF-4C-40 serial 68-603 taxies in trailing its brake parachute at RTAFB Udorn after a successful mission. Note the LORAN navigation antenna on the spine; this Phantom was one of 20 Block 40 and 41 RF-4Cs fitted with the AN/ARC-92 high-frequency radio suite, many of which served with the 14th TRS.
DAVID PAYNE VIA AUTHOR

in combat *per se* in Vietnam, the 14th TRS was flying reconnaissance missions over the Republic of Vietnam (RVN, i.e. South Vietnam) six days a week, monitoring the communist advance on Saigon and providing intelligence to both RVN and American policymakers. The one day a week the unit did not fly over the RVN was reserved for training. Bortz (**INSET, BELOW RIGHT**) was busy from the day he arrived and began logging combat sorties on a regular basis, learning his trade and reinforcing what he had been taught in training.

The Mayaguez

It was late in the afternoon on Monday, May 12, 1975, when the American embassy in Jakarta, Indonesia, received reports that the American-flagged container ship *SS Mayaguez* had been seized by Khmer Rouge revolutionaries. Earlier that day the ship had been in an international shipping lane 60 miles (95km) from the Cambodian mainland when it was attacked by a Cambodian gunboat and boarded.

As soon as American authorities were aware of the attack, US Pacific Command ordered US Navy Lockheed P-3 Orions to the area to locate and track the ship. That evening a P-3 spotted the *Mayaguez* stopped two miles (3·2km) north of the island of Koh Poulo Wai. The next morning the ship was under way heading north, but by 1100hr it was anchored a mile (1·6km) north of Koh Tang, a small island 29 miles (47km) south-west of Kampong Saom (Sihanoukville).

Back in Washington DC the administration of President Gerald Ford was determined to show decisive action, believing the reputation of the USA in the region was on the line after its withdrawal from Vietnam and Cambodia. Not wanting a replay of the *USS Pueblo* incident of 1968, in which American sailors were taken to North Korea, Ford directed Admiral Noel Gayler, Commander-in-Chief Pacific Command, not only to recover the crew of the *Mayaguez* but also prevent the Cambodians from taking the American sailors to mainland Cambodia.

Once the location of the *Mayaguez* had been ascertained, Gayler ordered the commander of the Seventh Air Force, Lt-Gen John J. Burns, to move combat aircraft to the area. In order to prevent the *Mayaguez* from reaching the Cambodian mainland, firing ahead of the vessel was authorised, as was permission to penetrate Cambodian airspace.

Orders from Seventh Air Force directed the 388th TFW to launch four Vought A-7 Corsair IIs and the 347th TFW to scramble two General Dynamics F-111As, all from RTAFB Korat. Once on scene, the F-111s noted numerous small boats moving between the *Mayaguez* and Koh Tang. Sent to investigate, the A-7s flew over the island, from which they took small-arms fire. As the day wore on, it became apparent that a longer-term plan would be needed.

By 1800hr on May 13 Gayler had directed Burns to maintain a constant watch over the *Mayaguez*. With the aircraft on station low on

"As Seventh Air Force airmen watched over the *Mayaguez* from above, a US Marine Corps battalion flew to U-Tapao in order to board USAF helicopters for a planned assault on Koh Tang..."

MAP BY MAGGIE NELSON

fuel, the 347th TFW launched two more F-111s from Korat, while the 16th Special Operations Sqn of the 388th TFW launched the first of the day's five Lockheed AC-130 gunship missions from the same base. Also taking off at this time was an EC-130E Airborne Battlefield Command & Control Center (ABCCC) of the 7th Airborne Command & Control Sqn, which had been deployed to RTAFB U-Tapao from Clark Air Base in the Philippines with two battle staffs to support Operation *Eagle Pull*.

As the situation continued to develop, American commanders determined the need to start controlling the events on the ground, and discretionary authority was given to attack and sink all small craft near Koh Tang. As Seventh Air Force airmen watched over the *Mayaguez* from above, a USMC battalion flew to U-Tapao in order to board USAF helicopters for a planned assault on Koh Tang. Although the 432nd TRW was not yet involved, its crews were watching the news and waiting for the call to go back into action. John Zink recalled: "When *Mayaguez* came up this really piqued everyone's attention — the adrenaline levels were quite high". The aircrew of the 432nd TRW would not have to wait long for their tasking.

A day of action

As May 14 dawned, Seventh Air Force was gearing up for a busy day, with orders going out to its three Wings to provide enough tactical airpower to monitor and manage the situation. The 347th TFW was tasked with providing 20 F-111 missions and the 388th TFW with ten A-7, 16 F-4 and six AC-130 missions, while the 432nd TRW launched 49 F-4 and six RF-4 sorties.

With the coming of daylight the AC-130 gunship monitoring the situation from above started to note boat traffic near Koh Tang. At around 0700hr three small patrol boats were spotted, and, after one disregarded shots across the bow, it was sunk by a flight of A-7s. Another boat with an estimated 40 persons aboard, predominantly Caucasian, was spotted making for the Cambodian mainland, and, fearing it contained the *Mayaguez* crew, riot-control gas was dropped on it. The Cambodian boat was not deterred and continued through the gas cloud. Later, when it appeared that all other boats in the area did not contain Americans, the ABCCC directed the tactical assets to engage and attack all Cambodian patrol craft.

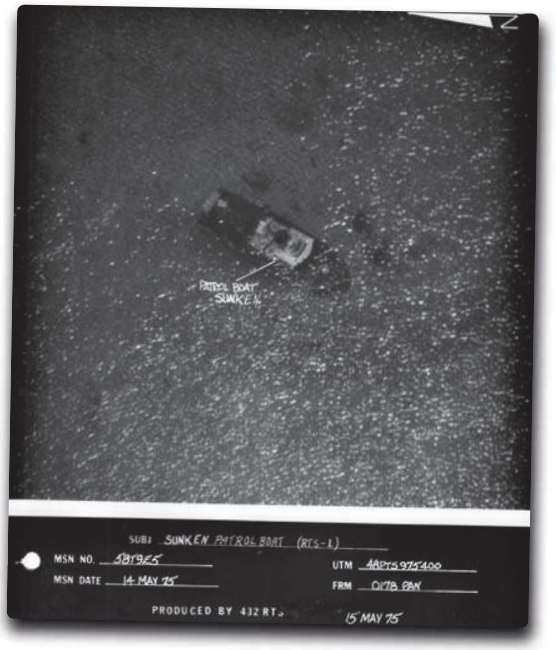
That day the 432nd TRW's 13th TFS launched 11 aircraft to observe the *Mayaguez* and deter further Cambodian forces from joining those already on board. The Panthers' F-4s carried either six Mk 82 unguided 500lb (225kg) general-purpose bombs (GPBs) or two Mk 84 2,000lb (905kg) laser-guided bombs (LGBs). John Zink was flying as *Citrus 4* with Capt Wayne Stuck as his WSO in an F-4E loaded with Mk 84s. The intelligence was sketchy, a characteristic of the entire *Mayaguez* operation, and Zink was told the threat at Koh Tang was "assessment unknown".

Departing Udorn at 0810hr, *Citrus* flight refuelled over southern Thailand before approaching Koh Tang. The ABCCC directed *Citrus* into a holding pattern, where it remained, watching other aircraft making attack runs on the Cambodian gunboats. As the flight's fuel state dwindled, the ABCCC contacted *Citrus* and directed one aircraft to make a low-level pass over the *Mayaguez* to determine the status of its

A Lockheed AC-130E Spectre of the 16th Special Operations Sqn at RTAFB Ubon, Thailand, circa 1972. The 16th SOS played a significant part in the **Mayaguez** *incident, when it was attached to the 388th TFW at RTAFB Korat. Visible beneath its starboard wing are the ALQ-87 electronic warfare pods the unit used to jam North Vietnamese anti-aircraft and surface-to-air missile radars.*

VIA AUTHOR

RIGHT ***A photo-reconnaissance image taken by an RF-4C of the 14th TRS of the Khmer Rouge gunboat sunk near Koh Tang by gunfire from an AC-130 and an A-7 during the afternoon of May 14. The vessel was one of 20 PCF (Patrol Craft Fast) Mk IIIs, known in US Navy service as "Swift Boats", built in the USA for export to Cambodia during 1972–73.*** AFHRA VIA AUTHOR



crew. *Citrus* lead, squadron commander Lt-Col Ben Nowland with WSO Capt Don Sandberg, directed the rest of the flight to stay at altitude, and rolled his F-4 into a dive towards the deck.

The F-4 accelerated as it descended and flew an arcing path across Koh Tang as it barrelled towards the anchored freighter. Spotting nothing unusual, *Citrus* lead returned to his formation and the quartet departed for Udorn. Although Zink had spent the 3hr 42min mission flying in circles, he was still excited to be part of the action taking place below.

The 13th TFS's sister squadron, the 421st, launched 12 aircraft that day, with most not seeing much action. At 1140hr the 421st's *Wild* flight of four F-4Es was directed to fly low to confirm the identity of two small boats spotted moving between Koh Tang and the *Mayaguez*. Once confirmed as Khmer Rouge gunboats, the ABCCC authorised *Wild* to engage with gunfire.

The two other F-4 squadrons of the 432nd TRW saw no direct action, their 26 aircraft holding east of the *Mayaguez* until they ran low on fuel and returned home.

Meanwhile...

To help authorities better understand what was happening on Koh Tang, the 14th TRS was tasked with providing six RF-4C sorties to track the *Mayaguez* and record the status of the ship and its crew. Jim Bortz launched that day in RF-4C serial 69-0377 with his flight commander, Capt Henry "Hard Turn" Johnson, as pilot. They were flying off the wing of squadron commander Lt-Col Ralph D. "Hoot" Gibson and Lt Reeves in RF-4C serial 65-0876.

Tasking for the RF-4Cs was a series of strip and point targets as well as visual reconnaissance. After refuelling in *Hickory Anchor*, just north of the Thai/Cambodian border, the Phantoms headed towards Koh Tang. Bortz's task was to photograph various portions of the island, looking for evidence of the crew of the *Mayaguez* and Khmer Rouge positions. While passing over the final target area, the two RF-4s were on the receiving end of light and inaccurate groundfire.

Once off target, Gibson checked in with the ABCCC and was directed to refuel and return

VIA WARREN THOMPSON

ABOVE ***Air-to-air refuelling played a vital part in enabling air support to remain on station throughout the* Mayaguez *incident, and F-4D-32 serial 66-8719 of the 13th TFS, wearing the unit's "OC" tailcode, is seen here taking on fuel during a mission. The 13th TFS "Panthers" had been deployed to Vietnam in May 1966 and remained in South-east Asia until June 1975.***

for further tasking. When he returned, Gibson was asked to look for Khmer Rouge gunboats. The two RF-4Cs then spent the rest of the day looking for enemy craft, cruising over the area at 10,000ft (3,000m) and dropping down to confirm the identity of such vessels, noting their position and passing it on to the ABCCC. The EC-130 would then task on-call fighters to sink them.

For Bortz, the afternoon became a blur of looking for gunboats, identifying them with a low pass, hitting the tanker for more fuel and going back to hunting boats, one of which stands out in Jim's memory. After acquiring the craft near the entrance to a small cove on Koh Tang, the two RF-4s dropped down to take a look. Flying at 100–150ft (30–45m) over the water at nearly supersonic speed, the Phantoms flashed by — and both were hit with exactly one round of anti-aircraft artillery (AAA) fire from either the shore or the boat.

After at least six aerial refuellings, the two RF-4Cs headed back to Udorn. By the time the Phantoms taxied into their parking revetments and shut down they had logged more than 8hr of flying time for the day, much of it spent "yanking and banking" at low altitude. Bortz recalled how his entire body hurt that evening and into the next day — it had been a draining sortie in every sense of the word. Bortz was later awarded the Air Medal.

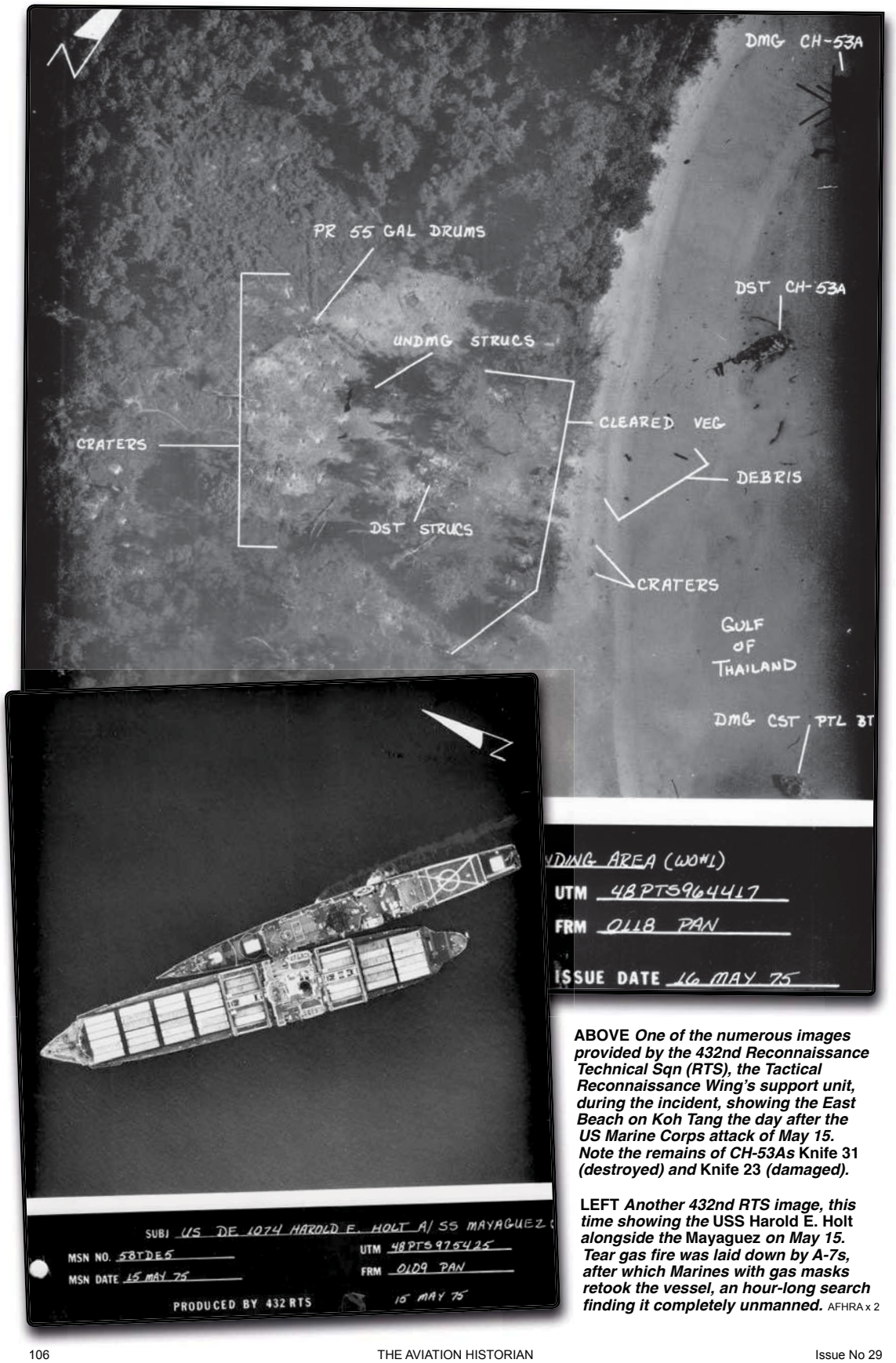
Shortly before leaving the area for the day, the last remaining A-7s dropped 2,000lb bombs near the *Mayaguez* as a warning not to move the vessel. As darkness fell, the fighters returned to base and attacks ceased for the evening. Overhead an AC-130 gunship maintained watch over the island and the *Mayaguez*, accompanied by an ABCCC which had replaced the EC-130 that had covered the day's action. The plan for the next day was a two-pronged operation set for daybreak. Marines would both be landed on Koh Tang to look for the crew of the *Mayaguez* and be put aboard the container ship itself.

Assault on Koh Tang

To support the assault on Koh Tang on the morning of May 15, Seventh Air Force scheduled 138 fighter/attack sorties, with the 432nd TRW launching 59 F-4 and six RF-4 sorties that day.

After a 0414hr take-off from U-Tapao, Marines aboard eight USAF Sikorsky CH-53 and HH-53 helicopters made an assault landing on Koh Tang at 0545hr, with the objective of liberating the crew of the *Mayaguez*, thought to be held captive on the island. The first wave of 175 Marines went in, but two helicopters were shot down and another was seriously damaged. Some 132 Marines were in place after the first wave, but the situation was far from stable and the crew of the *Mayaguez* was nowhere to be seen. That was soon to change.

At 0830hr, after being doused with riot gas by three A-7Ds of the 388th TFW's 3rd TFS, the *Mayaguez* was boarded by Marines from the destroyer escort *USS Harold E. Holt*. The ship was found to be empty and was soon taken under tow by the *Holt*. An hour later a small boat flying a white flag approached the *Holt* and was found to contain the crew of the *Mayaguez*, along with a missing Thai fishing-boat crew. Soon the crew and their ship were reunited and steaming out of the Gulf of Thailand towards Singapore. But the fight on Koh Tang was only just starting.



ABOVE ***One of the numerous images provided by the 432nd Reconnaissance Technical Sqn (RTS), the Tactical Reconnaissance Wing's support unit, during the incident, showing the East Beach on Koh Tang the day after the US Marine Corps attack of May 15. Note the remains of CH-53As*** **Knife 31** ***(destroyed) and*** **Knife 23** ***(damaged).***

LEFT ***Another 432nd RTS image, this time showing the*** **USS Harold E. Holt** ***alongside the*** **Mayaguez** ***on May 15. Tear gas fire was laid down by A-7s, after which Marines with gas masks retook the vessel, an hour-long search finding it completely unmanned.*** AFHRA x 2

LEFT ***Captain John Zink of the 13th TFS beside an F-4D at RTAFB Udorn shortly before the*** **Mayaguez** ***incident. The Phantom carries a Pave Knife laser designation pod on its port inner wing hardpoint and an ECM pod in the port forward missile well. Note the six red star "kill" markings on its splitter plate, acquired during the Vietnam conflict.*** CAPT JOHN ZINK

BELOW ***The*** **SS Mayaguez** ***was operating under the flag of the USA by Sea-Land Service as part of the Military Sea Transportation Service in support of American forces in South-east Asia, and on a regular Hong Kong—Singapore service via Sattahip in Thailand, when it was captured by the Khmer Rouge.***

John Zink was again partnered with Wayne Stuck in the back seat for another F-4 sortie by the Panthers on the 15th. Zink was part of *Dallas* flight, a mixture of four F-4Ds and F-4Es tasked with dropping LGBs in support of the island-assault force. The standard operating procedure for the 13th TFS was to fly LGB missions in a four-aircraft formation, with Nos 1 and 3 fitted with Pave Spike laser-designation pods.

Following a 1030hr take-off from Udorn, *Dallas* headed south for an aerial refuelling south-east of U-Tapao. Once over the Gulf of Thailand, the formation checked in with *Cricket*, the command-and-control crew aboard the ABCCC. The flight was directed to hold in an overwater orbit north of Koh Tang at 17,000–22,000ft (5,200–6,700m). *Cricket* was stacking fighter assets north and east of Koh Tang, creating something of a flying safety hazard as USAF and US Navy aircraft made attack runs on the island and Navy F-4s flew a protective combat air patrol (CAP) between Zink's position and mainland Cambodia. Looking at the chaos, John hoped he would have enough fuel left to be able to participate in supporting the rescue of the crew from the *Mayaguez*.

From high overhead Zink witnessed the fierce fight on the island as the Marines tried to stabilise the situation enough to be able to set up a perimeter and pull back off the island. A second helicopter lift brought in an additional 101 Marines, but what was needed was overwhelming firepower to push back the Khmer Rouge forces. The ABCCC was feeding aircraft into the fight and trying to co-ordinate the battle with the Marines on the ground. This was made more difficult by the fact that the Marines had lost their forward air control (FAC) team in the assault. An airborne FAC would not arrive on the scene until later in the day, so close air support was a very disjointed and tenuous endeavour for a good portion of the fight.

Zink's formation began to run low on fuel and *Dallas 3* and *4* departed for Udorn, with John remaining behind with the formation lead.

AFHRA

VIA WARREN THOMPSON

An F-4E of the 421st TFS over a typically South-east Asian landscape. The 432nd TRW was disbanded in December 1975, with the 14th TRS and the 13th TFS also disbanding. The 421st TFS and the 4th TFSs were returned to the USA, while the 25th TFS was deployed to Kadena on Okinawa, Japan.

Soon the call came from the ABCCC for *Dallas* to proceed inland and drop on a set of co-ordinates suspected of harbouring a concentration of Khmer Rouge soldiers. *Dallas 1* went in first, his experienced WSO in the back discerning the target and activating the Pave Spike designator. When within parameters, the pilot dropped his two Mk 84s. However, the bombs appeared to go ballistic, not guiding on the laser designator, and landed 1,000ft (300m) or so beyond the target.

Meanwhile, Zink remained clear of the target, holding at a higher altitude. *Dallas 1* determined that the Pave Spike pod had malfunctioned and directed John to drop his bombs ballistically, as if they were unguided GPBs. Zink acquired the target, dialled in the correct parameters into his bombsight and rolled his jet into a 45° dive. Once stabilised in the dive, he released his two Mk 84s as he passed through 10,000ft (3,000m) — the first time he had dropped two 2,000-pounders at one time. The bombs hit the target area and exploded. *Dallas 1* and *2* pulled off the target and formed up for the flight back to Thailand. Low on fuel, they landed at U-Tapao for gas before flying onward to Udorn, where the F-4s were greeted by enthusiastic crew chiefs and weapons personnel. The mission had lasted 4hr 30min.

The Panthers' other eight jets airborne that day also dropped weapons in support of the beleaguered Marines on Koh Tang, although the other flights were armed with unguided Mk 82 GPBs or LAU-3 rocket-projectile pods, along with centreline-mounted 20mm gun pods. Of the 12 F-4s the 4th TFS flew that day, two also dropped Mk 84 LGBs on Koh Tang. The 25th TFS launched 15 F-4Es, each loaded with six Mk 82s, with half dropping their ordnance on Koh Tang and strafing with their internal cannon. Finally, half of the 421st TFS's 16 F-4s expended ordnance that day, with *Cagey* flight dropping 24 Mk 82s on Koh Tang, and *Joyhop* flight attacking a Khmer Rouge gunboat.

Lessons learned?

As the 432nd TRW's jets were recovering at Udorn, the final spasm of violence was playing out on Koh Tang. With daylight starting to fade, the extraction of the Marines began at 1815hr and would not be completed until the last helicopter out at 2025hr.

Overall, the 432nd TRW had acquitted itself extremely well and the officers' club was busier than usual that night as the aircrew blew off steam and relived the day with fellow airmen. John Zink noted wing morale following what came to be known as "The *Mayaguez* Incident" as "outstanding". It proved to be John's last mission with the Panthers; he was soon on his way to the 59th TFS at Eglin AFB, Florida.

Nearly 75 USAF fighter sorties had been flown in support of the Marines, many provided by the 432nd TRW. In addition, US Navy air assets from the *USS Coral Sea* had struck Khmer Rouge facilities on the Cambodian mainland to restrict reinforcements from arriving. Tragically, 14 Marines, two Navy Corpsmen and two airmen were lost in the fighting — but national objectives had been met. The operation highlighted the considerable challenges of working in a multi-service environment — something that would take the USA's military another decade to embrace fully.

SOUTHERN EXPOSURE

TO BUENOS AIRES BY DE HAVILLAND MOSQUITO, 1946

When it was announced that Argentina was to host an aeronautical exhibition in late 1946, the British Foreign Office saw an opportunity to generate lucrative sales of surplus military equipment, including Rolls-Royce Merlin engines for a new Argentinian bomber. After one false start, an RAF Mosquito set a new record to Buenos Aires, as RICARDO M. LEZON relates

IN SEPTEMBER 1946 the Argentinian government announced that an aeronautical exhibition was to be held in Buenos Aires. Hearing of this in the UK, Ernest Bevin, the post-war Labour government's Foreign Secretary, arranged for an RAF de Havilland Mosquito to be sent across the South Atlantic on a goodwill mission, with a view to pursuing sales of surplus equipment to Argentina. Accordingly, on September 5, Wg Cdr J.H. Sindall visited AOC No 106 Group, Air Cdre Arthur W.B. McDonald, regarding the possibility of ferrying a photo-reconnaissance Mosquito to the Argentinian capital on a record-setting flight.

It was calculated that if operated at maximum cruising speed, a Mosquito PR.34 could fly from Benson in Oxfordshire to Buenos Aires in 24hr, with refuelling stops at Gibraltar, Dakar in Senegal (then part of French West Africa), and Natal and Rio de Janeiro in Brazil.

THE ROLLS-ROYCE CONNECTION

Back in early April 1946, Messrs Bennett and Levanti of Anderson & Levanti Ltda, Rolls-Royce's representative in Argentina, had arranged a meeting with *Secretarío de Aeronáutica Brigadier Mayor* Bartolomé de la Colina, *Director del Instituto Aerotécnico* (IAe) *Comodoro Ingeniero*

Juan Ignacio San Martin and Jack Burns of Rolls-Royce, regarding Merlin powerplants for the prototype of the IAe 24 Calquin piston-engined tactical bomber, which bore more than a passing resemblance to the Mosquito. Burns flew out to Buenos Aires aboard a British South American Airways Avro York to be met by Bennett and Levanti at Morón Airport. The meeting lasted two hours, Burns reporting:

"I was impressed with the enthusiasm of Comodoro San Martin for the Merlin project, and the anxiety of them all, including the *Ministro de Gabinete [Cabinet Minister]*, to see the [Calquin] prototype flying. I am visiting the Instituto Aerotécnico, where the prototype is being built, with San Martin and Bennett. They assure me the aircraft is well advanced and is at a stage to receive the Merlin for installation.

"It was originally intended to fit 1,050 h.p Pratt & Whitneys [P&Ws], but performance will be poor and San Martin has always wanted the Merlin. Two sets of wings have been built; one for Pratt & Whitneys and the other for Merlins. The prototype will fly first with the P&Ws but there is no competition, as the decision has been taken to fit the Merlin if the machine is anywhere near the estimated performance. I'm given to understand that the machine is virtually a 'Chinese copy' of the Mosquito. In order, for political reasons, to get the machine flying, San Martin agreed we either convert new engines or buy back [unused] Merlin Mk 104s from the MAP [UK Ministry of Aircraft Production] and recondition them for sale to [the Argentinians]."

The Merlin Mk 104 was exactly the same as the Mosquito's Mk 114 but with a lower supercharger gear ratio. No Merlin 104s were put into service, those built being surplus, probably hence why they were offered to Argentina. The resulting Merlin 604 was essentially a 600 but with a Mk 36 first-stage supercharger diffuser (to prevent surging at altitude) and a cabin blower. The 604 was specially modified in this way for the Calquin. On completion of modifications and testing in the UK, two Merlin 604s were crated for shipment and left Rolls-Royce's Derby plant during June 21–29, 1946.

On July 4 that year the P&W-powered Calquin prototype made its maiden flight, with *Capitán* Osvaldo M. Rovere, then *Jefe de Pilotos de Prueba del Instituto Aeronáutico* (IAe chief test pilot) at the controls, with San Martin as flight observer. During the 60min flight, the Calquin attained a maximum speed of 470km/h (292 m.p.h.) at 8,500m (28,000ft), a cruising speed of 440km/h (273 m.p.h.) at the same height and a service ceiling of 10,000m (33,000ft). It was predicted that the Merlin would offer the aircraft a maximum speed of 680km/h (423 m.p.h.), a cruising speed of 610km/h (379 m.p.h.) and a service ceiling of 14,000m (46,000ft).

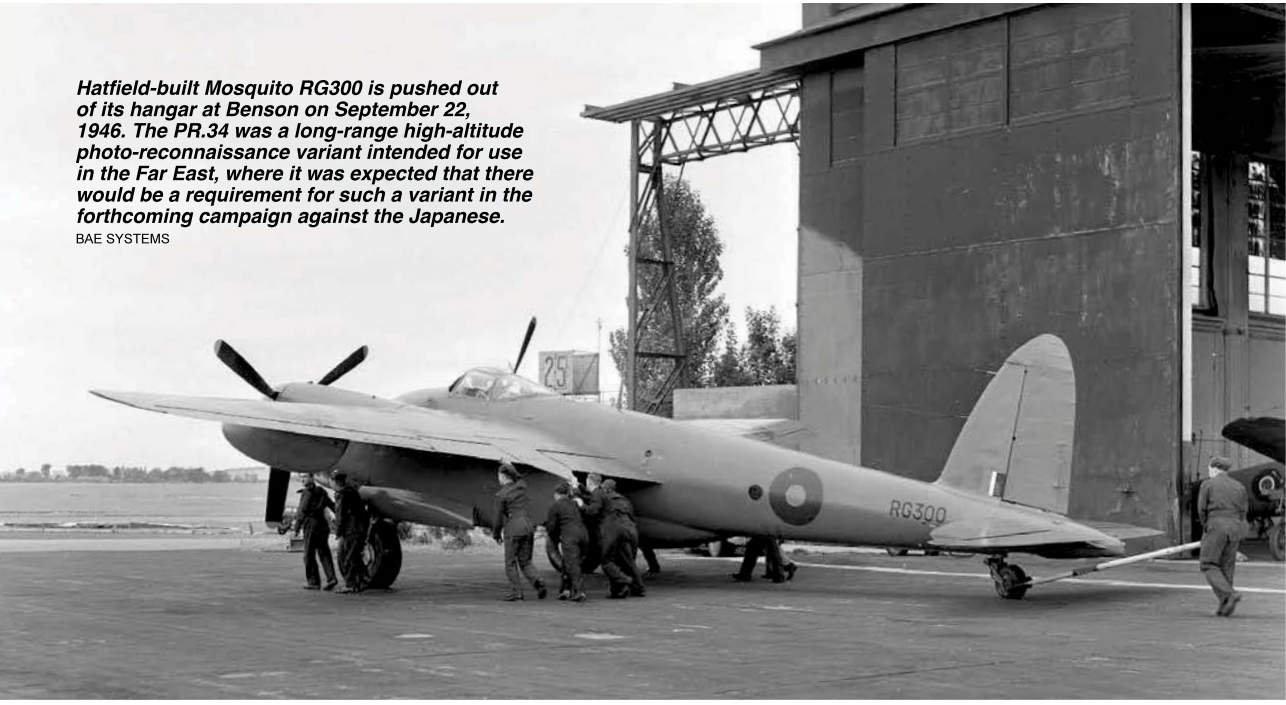
THE MERLIN PLAN

The Argentinian government's intention was to build Merlins under licence. In July 1946 Ernest Hives, Rolls-Royce's Managing Director, tasked distinguished engineer Stanley Hooker, then in Argentina recuperating from wartime overwork, to negotiate terms. Hooker fixed a

OPPOSITE PAGE ***The first Mosquito despatched to Buenos Aires for the aeronautical exhibition in October 1946, PR.34 RG300, undergoes final preparations at Benson before setting off on the first leg of its transatlantic flight on September 22 that year. Unfortunately it came to grief after landing at RAF Yundum in The Gambia the following day.*** BAE SYSTEMS

BELOW ***Resembling a less refined Mosquito, after which it was patterned, the IAe 24 Calquin twin-engined tactical bomber was a prime candidate for the supply of surplus Rolls-Royce Merlin engines from the UK, but the type was ultimately fitted with Pratt & Whitney Twin Wasp radials instead. A total of 100 production examples was built by IAe.***

VIA AUTHOR



Hatfield-built Mosquito RG300 is pushed out of its hangar at Benson on September 22, 1946. The PR.34 was a long-range high-altitude photo-reconnaissance variant intended for use in the Far East, where it was expected that there would be a requirement for such a variant in the forthcoming campaign against the Japanese.
BAE SYSTEMS

meeting with San Martin and Reggie Longinotto, Angel Levanti and John Bruton, a former wartime Royal Canadian Air Force instructor, of Anderson & Levanti, regarding the deal.

Hooker and Bruton set off for Córdoba to visit the IAe factory, which Hooker concluded was not sufficiently equipped to produce such a sophisticated aero-engine. So much for the idea of building the Merlin in Argentina. Hooker did, however, offer to talk to Derby to ask for the provision of full details of the Mosquito's engine installation and nacelle design, so that the IAe would only have to build the airframe. The IAe readily accepted and showed Hooker the Calquin prototype.

Hooker returned to Buenos Aires and reported to Hives that the Merlin production idea was a non-starter but to send details of the Mosquito's powerplant installation forthwith. Accordingly, a set of Merlin drawings was despatched from Derby to be transported aboard BSAA York G-AHEW *Star Leader*, which unfortunately crashed shortly after take-off from Bathurst (now Banjul) in The Gambia on September 7. A second set was sent, but by the time it arrived the situation had changed dramatically, the IAe having made the decision to fit P&W Twin Wasps to all production Calquins instead.

In Argentina, Hooker saw the forthcoming aeronautical exhibition in Buenos Aires as an excellent opportunity to show Rolls-Royce's innovative new Derwent turbojet engine. Hives initially refused, saying it risked prejudicing the Merlin sale, but later relented on hearing Hooker's negative report from Córdoba, and agreed that it may well be wise to look to the future instead. The Derwent was ultimately shown at the exhibition and was later selected to power the Émile Dewoitine-designed IAe 27 Pulqui I jet fighter. However, the Argentinian government was still interested in acquiring the Mosquito as a "high-speed courier".

THE FIRST ATTEMPT

Mosquito PR.34 RG300, selected for the transatlantic flight from the RAF's Photographic Reconnaissance Development Unit (PRDU) at Benson, was one of a batch of 118 examples built at de Havilland's Hatfield factory. Delivered to the RAF on October 1, 1945, it was placed directly into storage with No 27 Maintenance Unit (MU) at RAF Silloth in Cumbria, and was still there when the Air Ministry conducted its Home Census on March 21, 1946. It was delivered to Benson on September 13 that year, officially joining the PRDU a week later.

The crew detailed to undertake Flight AF122 comprised Flt Lts Stanley McCreith DFC and Frederick E. Thayer DFC. The former had been granted an emergency commission in June 1942 and was promoted Pilot Officer the following year. He underwent photo-reconnaissance (PR) training with No 8 Operational Training Unit (OTU) at Dyce, near Aberdeen, during March–April 1944. McCreith's operational career ended abruptly on October 13, 1944, when he failed to return from a sortie to Austria from San Severo in south-eastern Italy, in Mosquito PR.XVI MM287. A telegram from the International Red Cross Commission quoting German information stated that McCreith and his navigator had been captured as prisoners of war. McCreith was liberated from *Stalag Luft IIIA* and was returned to the UK on April 15, 1945.

On the afternoon of September 22, 1946, RG300 sat on the ramp at Benson awaiting its crew.

LEFT ***Last-minute adjustments are made to RG300 at Benson before the flight on September 22. Powered by "handed" Merlin 113 and 114 engines, the PR.34 had a potential range of more than 3,500 miles (5,600km), achieved by fitting an overload fuel tank in the bomb bay and doubling the size of the wing tanks.*** BAE SYSTEMS

BELOW ***McCreith and Thayer depart Benson on the afternoon of September 22. The PR.34 was a tricky aircraft to handle, and received a somewhat unfavouable report from test pilots during its acceptance trials. Some 181 were built, 50 by Percival at Luton.***

At 1400hr, after maps, charts and logsheets had been prepared and preliminary checks completed, McCreith and Thayer were inspected by Air Cdre McDonald and Wg Cdr Sindall, who gave them a few words of advice and bade them farewell. McCreith and Thayer climbed into the aircraft through the hatch below the cockpit.

Completing final checks, McCreith ordered the chocks away and taxied to the end of the 1,910yd runway. The control tower gave the green light and McCreith opened the throttles. At 1500hr local time the blue Mosquito lifted from the runway before making a turn to port as the undercarriage retracted. McCreith and Thayer set course for their first stop at Gibraltar, via the Brest peninsula, Bay of Biscay and Spain.

The fuel drill was to take off and climb on the main tanks and cruise on the 58gal outer tanks. When the fuel in the latter dropped to 20gal, the navigator opened the transfer cocks for the fuel lines from the underwing tanks into the outers. After 2–3min (when the outers had reached 50gal) the transfer cocks were turned off. Fuel consumption was around 90gal/hr so it took more than 2hr to empty the underwing tanks.

After slightly less than 3hr 20min flying time RG300 landed at Gibraltar to refuel. At 1907hr local time the Mosquito set off again, this time for Dakar. When nearing their destination McCreith and Thayer failed to establish radio contact. The airfield at Dakar was still in the process of being handed over to the French by the Americans and, as a result, the French authorities had not been able to install any up-to-date landing aids. The Mosquito crew decided to divert to RAF Yundum near Bathurst instead, using the latter's radio beacon for homing.

At 0150hr on September 23, RG300 touched down at Yundum. It was here that events began to unravel. "I throttled back," reported McCreith, "with the starboard engine popping a bit. I taxied to the end of the runway, where it was as black as pitch, and the engine just stopped. I pressed the starter, and there was, of course, a spurt of flame from fuel collected in the starboard exhaust system. The people on the ground thought we were on fire and in no time at all sprayed us thoroughly with foam. While we were clambering out, the Mosquito was struck by an ambulance". The driver of the

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ABOVE ***Mosquito VL618 was part of the same batch of 13 de Havilland-built PR.34s as RG300's replacement, VL613. For optimum performance, the Mosquito cruised at 360 m.p.h. (580km/h) at 30,000ft (9,150m), at which the oxygen lasted 9hr. Dropping to 20,000ft (6,100m) would give 12hr of oxygen but a reduction in economy and speed.***

ambulance had panicked and struck the aircraft, hitting the starboard wingtip, tearing the aileron.

The damage to the Mosquito, declared as Category A, meant the aircraft could be repaired on site. Fevered attempts were made to render the aircraft airworthy again, but after much effort by both RAF and de Havilland staff, it was decided that a replacement Mosquito should be selected and prepared at Benson. On September 25 the crew returned to the UK aboard BOAC Douglas Dakota G-AGHP.

THE SHOW MUST GO ON

The replacement, VL613, was selected for its low operational hours from the inventory of No 8 OTU. One of a batch of 13 PR.34s completed at Hatfield in early 1946, the aircraft spent some time there awaiting collection by an operational unit. On January 28 that year it was moved to Benson to serve with No 1 Photographic Reconnaissance Unit (PRU). Specifically, it went to a unit known as "IP & IP" — Initial Preparation & Installation, Photographic. On June 26 it was put on strength with No 8 OTU.

With the replacement Mosquito fully prepared, McCreith and Thayer were sent to try again, and, at 1902hr local time on September 27, they departed Benson for Gibraltar. Their approved route took them outside the territorial waters of Spain and Portugal before turning east for "The Rock", where they landed at 2202hr (local).

At 0239hr local time the following morning McCreith, Thayer and VL613 were airborne again and heading to Yundum, where RG300 had come to grief, and where they arrived at 0910hr local time. After a quick turnaround they set off again at 1125hr for Natal in north-eastern Brazil. It was at this point that misfortune frowned on the flight again.

Flying at the optimum altitude for the Atlantic crossing would be of crucial importance, but it was found that the oxygen supply was leaking, albeit slowly. The calculations made depressing reading. Even with no headwind, the Mosquito

BELOW ***Mosquito VL613 at Morón after its arrival in Argentina on October 2, the local newspapers reporting it as "the end of a misadventurous flight". Partly obscured by the Mosquito's fin is a Braniff Airways Douglas DC-3 sent from the USA to demonstrate Sperry autopilot equipment to the Argentinians during the Buenos Aires exhibition.***

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MAP BY MAGGIE NELSON

would not have the range to reach Natal unless flown at 22,000ft (6,700m) or above, where the superchargers cut in, making oxygen an absolute must for the crew. But they had only a little — and that was ebbing away.

At 30,000ft (9,150m) an oxygen-supply failure for less than a minute is fatal, and there was no positive way of knowing when the supply would dwindle to nothing, resulting in hypoxia for the crew. Regulations stipulated that oxygen must be turned on at altitudes above 10,000ft (3,050m). Prudence and training demanded a return to Yundum, where the Mosquito landed at 1425hr. The subsequent inspection revealed a fault with the oxygen system, so a request was issued for replacement oxygen tubes.

On September 30 the Station Commander at RAF Gibraltar received an urgent cable from the Air Ministry, reading "Rush oxygen to Yundum". Accordingly, at 2258hr local time, a Handley Page Halifax VI of No 518 Sqn departed Gibraltar with the precious cargo, arriving at 0743hr local time the following morning. The replacement tubes were installed by groundcrew at Yundum that afternoon.

After a good night's rest in comfortable — if primitive — accommodation, McCreith and Thayer rose for an early breakfast and paid a visit to the meteorological department for the relevant weather reports. The Mosquito had been refuelled and the oxygen tanks replaced. McCreith filed a flight plan and the pair boarded VL613. At 0810hr on October 1 the Mosquito and its crew departed for Natal, where the aircraft arrived, after a perfect crossing, within a few minutes of the original estimated time of arrival after a flight time of 6hr 55min. Following a brief stop at Natal, McCreith and Thayer pushed on to Rio de Janeiro, leaving the Brazilian capital on the final leg the next day at 1210hr.

On October 2, 11 days after having started their epic journey from Benson in RG300, McCreith and Thayer finally arrived, in VL613, at Aeropuerto Internacional Presidente Rivadavia at Morón, Provincia de Buenos Aires, at the end of an uneventful 3hr flight. After landing, McCreith and Thayer were met by Secretario de Aeronáutica de la Colina, *Teniente* Rafael A. Gandolfo, HBM Air Attaché Wg Cdr Walter Beisiegel and Civil Assistant Air Attaché R.H. Haven Dyke. Secretario de la Colina congratulated the two officers on the success of their flight and expressed his thanks to the British government for sending the aircraft.

Later the same day the Mosquito was flown from Presidente Rivadavia Airport to *Base Aérea Militar* (BAM) El Palomar, where it was overhauled. Once this was completed, along with engine checks and a test flight, the crew was scheduled to demonstrate the aircraft at El Palomar, Mendoza, Villa Mercedes and Córdoba before returning to Buenos Aires.

SHOWING OFF THE WOODEN WONDER

The aeronautical exhibition started in Buenos Aires on October 7, when the Mosquito was demonstrated to officers of the *Fuerza Aérea Argentina* (FAéA — Argentinian Air Force) and its Commander-in-Chief, *Brigadier* Oscar E. Muratorio, and his staff at El Palomar.

The following day the Mosquito set off for Córdoba for more demonstration flights, accompanied by Beisiegel in the British Embassy's Avro Anson XII, PH617. On October 9 the Mosquito was displayed for the officers and cadets of the *Escuela de Aviación Militar* (Military Aviation School) and IAe personnel at Córdoba. Before taking off, McCreith and Thayer were alarmed to see a thick black swarm of locusts drifting across the airfield, although they undertook their display nevertheless. On landing, the Mosquito's windscreen was thick with a layer of dead locusts. Worse, the radiators

CARLOS MOTTA VIA AUTHOR

ATILIO BALDINI VIA AUTHOR

ABOVE ***A poor-quality but rare image of VL613 at Galeão airport, now Antonio Carlos Jobim Airport in Rio de Janeiro, Brazil. Taken during the aircraft's visit to South America in October–November 1946, it is possibly seen here during its extended stay there on its return journey to the UK.***

LEFT ***Argentinian military staff at BAM Coronel Pringles, near Villa Mercedes, pose with VL613 on October 11, during McCreith and Thayer's demonstration tour of air bases with the Mosquito.***

The Mosquito drew admiring crowds wherever it visited in South America, with McCreith and Thayer performing spirited displays in the aircraft during its demonstration itinerary. McCreith would later be reunited with VL613 at Seletar, Singapore, where he found the aircraft on strength with No 81 Sqn when he was appointed the unit's CO in August 1954. After a period in storage during 1952–53 the Mosquito had joined the squadron in February 1954. It served until October 1955, when the record-setting aircraft was finally withdrawn from service and scrapped. BAE SYSTEMS

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ABOVE ***The reception for the Mosquito and its crew after their arrival at Buenos Aires. From left to right:*** **Teniente** ***Rafael Gandolfo of the FAéA; Flt Lt Frederick Thayer; Flt Lt Stanley McCreith and Wg Cdr Walter Beisiegel, the British Air Attaché in Buenos Aires. No Merlin sales resulted, but the FAéA did acquire Gloster Meteors in 1947.***

were blocked solid with the insects, which, with their wings sheared off, fitted the honeycomb structure like plugs. At Córdoba the IAe's engineers made the most of the opportunity to evaluate the Mosquito's airframe fully.

Two days later McCreith and Thayer set off in VL613 for San Luis in central Argentina, where the aircraft was demonstrated to the officers of BAM Coronel Pringles at Villa Mercedes, Provincia de San Luis, before its return to Buenos Aires. On the morning of October 12, the *Porteños* (residents of Buenos Aires) thrilled to the sight of the Mosquito buzzing the city in a celebration to mark the end of the aeronautical exhibition. Hundreds thronged to the Costanera to see the "wooden wonder". With a brisk wind blowing from the south, McCreith took off from El Palomar and headed to Buenos Aires. He flashed the roaring Mosquito over Río de la Plata at 400 m.p.h. (650km/h), followed by a series of upward rolls, to the amazement of the spectators, before returning to El Palomar.

On October 21 McCreith and Thayer left Buenos Aires in VL613 on the first leg of their journey home. A wait in Brazil for a replacement radiator provided an opportunity to introduce the Mosquito to de Havilland Service representatives there. On November 15 the crew bade a fond farewell to South America and set off across the Atlantic. The route home was similar to that followed on the way out, with the addition of a refuelling stop in Dakar between the landings in Bathurst (rather than Yundum) and Gibraltar.

The 1,900-mile (3,000km) trip across the South Atlantic from Natal to Bathurst took 5hr 45min — probably faster than any previous time for the trip — at an average speed of about 330 m.p.h. (530km/h). Two more easy stages via Dakar and Gibraltar brought the Mosquito back to Benson on November 21. The aircraft had accrued about 70 flying hours during the trip with nothing but the most rudimentary maintenance by personnel with no experience on Mosquitoes. On their return to Benson, McCreith and Thayer set about preparing operational procedures based on the information they had gathered during the trip, including technical details about performance and fuel consumption.

Unfortunately, no sales resulted. The Merlin contract ultimately came to naught and all production Calquins were powered by 1,050 h.p. Pratt & Whitney R-1830 Twin Wasps.

ACKNOWLEDGMENTS *The author would like to thank the following for their invaluable assistance with the preparation of this feature: RAF Air Historical Branch; BAE Systems Heritage; Fleet Air Arm Museum; Ian Thirsk (Royal Air Force Museum); Rolls-Royce Heritage Trust; Alec Audley; David Birch; the late Juan C. Cicalesi; Peter Collins; Ronald Cork; Richard de Boer; Jonathan Falconer; Mike Hatch; Carrie La Follette; Norm Malayney; Carlos F. Motta; Andy Nicholson; David Ogilvy; Brian Pilgrim; Brian Rivas; Carlos Scudeler; Robert M. Stitt; Alan Thomas and Ted Wilkings*

ARMCHAIR AVIATION

We take a look at what's available for the aviation history enthusiast in the world of books and other literature, from hot-off-the-press publications to reissued classics

Gott Strafe England — The German Air Assault Against Great Britain 1914–1918; Volumes 1–3

By Nigel J. Parker; Helion & Company, Unit 8, Amherst Business Centre, Budbrooke Road, Warwick CV34 5WE (available from www.casematepublishing.co.uk); all volumes 6in x 9¼in (156mm x 235mm); Vols 1 and 2 softback, Vol 3 hardback; Vol 1 — 421 pages; Vol 2 — 472 pages; Vol 3 — 343 pages, all illustrated; all £29.95. ISBNs Vol 1 — 978-1-911628-37-8; Vol 2 — 978-1-911628-39-2; Vol 3 — 978-1-911512-75-2

THE TITLE OF this three-volume work comes from a German slogan of 1914–15, meaning "God punish England". Several books have been published recently about the German air raids on the UK in the First World War, and this is the longest and at first sight the most comprehensive. However, it is only comprehensive in certain respects.

Different books on the subject have different emphases. Some are histories of the German military and naval airships at war, covering airship operations over the Eastern Front as well as against the UK. In this series Nigel Parker also covers the raids by aeroplane bombers such as the Gothas, and even the seaborne bombardments, but he sticks mainly to the history of raids on the UK and the countermeasures that evolved as a result. Too much rigidity leads to some distortions: he cites the raid by a single German seaplane on Dover on Christmas Day 1914, which was a very minor affair with no casualties, as the start of the whole history of strategic bombing of civilian targets, but omits to mention the bombing of Antwerp by Zeppelin Z IX on August 25 that year, in which several people died, and which was much more of a harbinger of things to come.

Volume 1 covers the period up to the end of 1916, and Volume 2 covers 1917 and 1918; both have substantial appendices of extra information. Volume 3 is a further appendix comprising even more information, e.g. detailed contemporary crash reports of airships and aeroplanes. There is plenty that may be new even to those familiar to the subject, e.g. a lecture given by Graf von Zeppelin himself. The author's prinicipal *modus operandi* has been to mine the Air Files in The National Archives (TNA) — he admits that Kew feels like a second home — and reproduce the relevant contemporary reports verbatim, especially the first-hand combat reports by Home Defence airmen. Many readers will appreciate these as they will never read these documents anywhere else, but arguably he relies too heavily on them. Generally, he uses his own words to recount the various bombing raids on British cities, but for some operations, such as the Friedrichshafen and Tondern Raids, he relies almost entirely on reproducing the combat reports in TNA files. Combat reports have their pitfalls; the writers had no idea of the bigger picture, and their accounts of the results of their actions sometimes involve wishful thinking or worse. Parker offers very little analysis; it is all facts and statistics.

There is an introduction and a brief conclusion, but even these are primarily about the history of strategic bombing as a whole. For every raid on the UK, he supplies tables of the anti-aircraft rounds fired by each anti-aircraft artillery site, which even the most obsessive enthusiast will probably skip over. But he rarely names the civilian casualties of the raids, which are given in other books and often include children and whole families. This is disappointing, especially as he names the German airmen who were shot down. It is important for those of us who cite military history as a hobby to remember that war is about human tragedy, not just military heroes and technology.

Happily, there are no huge errors and generally the books are well-edited, but there are some minor errors and some annoying misprints. On its final flight, L 33 dropped bombs on Bromley-by-Bow, East London, not Bromley, Kent. The

account of the final airship raid that caused casualties in England, on April 12, 1918, states that five civilians were killed; another book states that seven were killed and names them. Sablatnig was a make of German seaplane, not "Sablating". Less forgivably, Manston airfield is misspelt "Manstone". And this is not the only recent book to spell Reginald Marix's name as "Matrix", at least in the photo captions.

There are copious photographs, some familiar and many others rarely seen, but the reproduction is poor compared with some other books. There is an index, but it is not comprehensive; I was unable to find some subjects that I was looking for.

These books are an important piece of work and a valuable and intriguing source for the serious enthusiast or researcher. But for the newcomer to the subject looking for a basic introduction, there are books that are more appropriate, especially in view of the price. Volume 3 is fascinating, but for the hardcore enthusiast or serious researcher only.

ADRIAN ROBERTS

The Dawn of Carrier Strike and the World of Lieutenant W.P. Lucy DSO RN

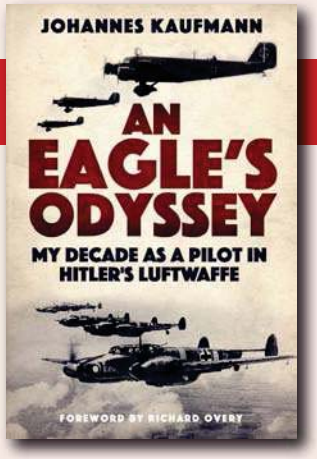
By David Hobbs; Seaforth Publishing, 47 Church Street, Barnsley South Yorkshire S70 2AS; 6½in x 9½in (167mm x 241mm); hardback; 386 pages, illustrated; £35. ISBN 978-1-473879-92-8

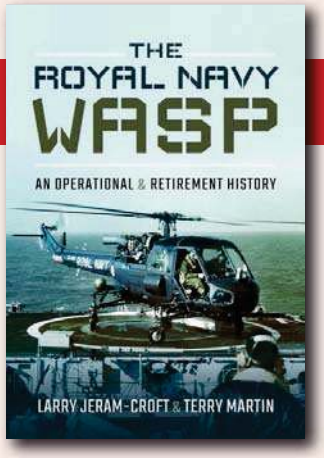
The Dawn of Carrier Strike represents, in many ways, a continuation of David Hobbs's excellent series on the history of UK naval aviation, following his impressive works on the British Pacific Fleet and post-war carrier strike. In one important respect, however, this new work differs from Hobbs's recent output, as the book is both a general history of the interwar and early Second World War Fleet Air Arm (FAA) and a biography of sorts of the naval aviator William Paulet Lucy DSO. I first became aware of Lucy and his remarkable (and tragically truncated) career when working on a book on the Blackburn Skua some 12 years ago, and it is refreshing to see him now receive the attention he has long deserved. Lucy epitomised both the skill and dash of the interwar Fleet Air Arm officer, and did much to shape its future in the late 1930s until his untimely death in 1940.

If there was any difficulty in combining these twin tasks into a single cohesive narrative, Hobbs doesn't show it. With some aplomb, he seamlessly integrates the chapters on Lucy into the whole, using Lucy's experience to demonstrate how the factors influencing the FAA's development were felt at the level of an individual officer. Lucy also acts as a perfect example of an officer serving through the sometimes less-than-peaceful peacetime years, the end of the destructive "dual control" period of naval aviation, and the painful lessons of the early Second World War.

Hobbs has a talent for taking the broad view, analysing the politics and personalities of the time as well as the "nuts and bolts" of fleet exercises, hardware procurement and operational activity. He articulates more clearly and convincingly than any account I have hitherto seen how the FAA ended up with compromised equipment and narrow strategic focus on the outbreak of war in 1939. Such is Hobbs's commitment to the most comprehensive possible study of the development of UK carrier strike that he devotes significant space to comparisons with the American and Japanese navies' approaches. This highlights issues that would not be entirely apparent from a narrower focus, such as the importance of maritime patrol, and how the lack of Royal Navy control over this area compromised the Fleet Air Arm.

Although this may be a "big-picture" book, that does not mean the detail is lacking. Hobbs provides illuminating discussions of FAA





personnel, their ranks, trades and roles, the aircraft in the inventory at the outbreak of war (although the carriers are not covered as thoroughly), training, and unit structure.

The last third of the book is given over to the Norwegian campaign of 1940, following the German invasion, and a retrospective look at how this influenced later doctrine. It is here, Hobbs posits, that the modern concept of carrier strike was born, by force of circumstances and the inability of the RAF to support operations. All in all, *The Dawn of Carrier Strike* provides the most comprehensive and convincing exploration yet attempted of the formative years of British "force projection", and is highly recommended.

MATTHEW WILLIS

An Eagle's Odyssey: My Decade as a Pilot in Hitler's Luftwaffe

By Johannes Kaufmann; Greenhill Books, 83 Bedford Road; East Finchley, London N2 9DB (available from www.casemate.co.uk); 6½in x 9¼in (165mm x 234mm); hardback; 234 pages; illustrated; £19.99; ISBN 978-1-784382-53-7

ALONGSIDE THE MEMOIRS of the Luftwaffe's leading fighter aces (Galland, Steinhoff, Rall, etc) sits a small number of accounts from lesser-known pilots, who, while perhaps not gaining such impressive victory scores and accolades from a grateful Third Reich, nevertheless flew just as much and experienced just as much of a war as the aces.

One such pilot was Johannes Kaufmann, and as a student of Luftwaffe history I enjoyed reading his book, primarily because of his varied operational career which saw him fly in most German theatres of war as an instructor; a *Zerstörer* ("destroyer") in both Russia and over the Atlantic; a fighter-bomber pilot and, at the end of the war, as a fighter pilot flying the Messerschmitt Bf 109.

This is a book packed with active reminiscence, but Kaufmann does mention one point which particularly intrigued me: much has been made in post-war literature of the Luftwaffe's and Wehrmacht's successful air-ground co-operation and co-ordination — at least during the German campaigns of conquest between 1939 and 1942. The popular conception is that "it worked" and the evidence is there to bear this out. However, in 1942, Kaufmann was flying Messerschmitt Bf 110s with ZG 1 in Russia and he comments that the Luftwaffe's air liaison officers, who accompanied the Panzers, and the pilots in the air "had great difficulty in understanding each other". Kaufmann asserts that it was "simply impossible to respond swiftly and effectively to the situation reports and target information that we were being fed from the ground". So much for that.

This is a pacy read, although with well-known Luftwaffe writer John Weal engaged as translator, it's possible that it may have benefited from some "expert" handling and retouches. Nevertheless, Kaufmann conveys well the Luftwaffe's endless staging back and forth, from sector to sector in the East as it supported the ground forces, but a disappointing omission is an index which, in a book crammed with many references to battles and units, this reader views as essential. There are also no illustrations; the book was first published in Germany in 1989 and I have no idea whether, in the original edition, photos were included. Even if no snapshots of Kaufmann exist, a few photos of the aircraft types he flew and/or the units with which he served would have been easy to come by and would have given this very good book an extra gloss. This aside, *An Eagle's Odyssey* is one of the more absorbing, varied and enjoyable Luftwaffe memoirs. Recommended.

ROBERT FORSYTH

Iron Cross German Military History 1914–45

Warners Group Publications; Quarterly magazine, print and digital; Editor Andy Saunders, e-mail andy.saunders@warnersgroup.co.uk; PO Box 4984, Windsor SL4 9FN; website www.warnersgroup.co.uk/militaria-history/iron-cross

WHEN WE LAUNCHED *TAH* back in October 2012, we were convinced that there was a workable model, financially and editorially speaking, to create a publication that catered for rather more niche tastes than were being provided by the mainstream aviation monthlies. And so it has proved over the course of seven years and 29 issues. So it is heartening to see the recent emergence of a number of new independent aviation-related publications (q.v. *Wing Leader* reviewed here in *TAH27)* and this new venture, which burrows a level deeper, into a niche of a niche. Edited by veteran author, broadcaster and magazine editor Andy Saunders, *Iron Cross* is a high-quality 8¼in x 10½in (210mm x 270mm) English-language quarterly softback magazine focusing entirely on German military history during the 1914–45 period, containing articles from a stable of highly respected and knowledgeable authors, accompanied by well-reproduced and often previously unpublished photographs and illustrations. The first issue manages to pack nearly 20 fascinating articles on various aspects of the 20th-Century German war machine into its 130 pages, with much of it being aviation-related, from the birth of German ground-support strategy during the Great War to a fine feature on Luftwaffe operations during D-Day from *TAH* contributor Chris Goss. This is unquestionably a quality product, and we wish it *"Hals- und Beinbruch"!* **NS**

The Royal Navy Wasp — An Operational & Retirement History

By Larry Jerram-Croft and Terry Martin; Pen & Sword, 47 Church Street, Barnsley, South Yorkshire S70 2AS; 6¾in x 9¾in (175mm x 249mm); hardback; 280 pages; illustrated; £25. ISBN 978-1-526721-14-7

THIS BOOK PROVIDES a warm and affectionate look at the relatively little-known turbine-powered Westland Wasp small-ship anti-submarine helicopter, drawing on material from the Royal Navy's *Cockpit* and *Flight Deck* magazines, augmented by numerous first-hand accounts from pilots and engineers. These are variously gripping, exciting and sometimes amusing, but all told with that "I was there" directness that carries complete conviction.

The book addresses the type's *raison d'être* — the need for a small-ship helicopter for anti-submarine work, capable of operation from small ships in all weathers. The main chapters summarise the nature of the requirement; the origins of the design; the subsequent development of the Saunders-Roe P.531 (a turbine-powered Skeeter) into the Westland Wasp; roles & weapons; and the type's use in major operations, including the Cod Wars and the Falklands conflict. There follow further personal accounts of operating and supporting the Wasp in Royal Navy service.

The second main section of the book describes Wasps in overseas service and in civilian use after the type's retirement from military service. This section provides a comprehensive summary of all the aircraft operated by export customers. Tabular information is provided relating to all surviving Wasp airframes that are airworthy, currently on display or in storage. The content is enlivened by a series of humorous cartoon illustrations provided by Steve George.

The book is not without faults, however. The text is full of acronyms and naval slang terms and a glossary is provided — unfortunately, this is far from complete. There are a surprising number of basic spelling mistakes, suggesting a poor standard of proofreading by the publisher. There is also no index, which is always a significant and frustrating omission.

In addition, there are a few straightforward errors. These are mainly in two categories — incorrect presentation of company names and aircraft designations, and some misattribution of technical developments. For instance, in respect of Cierva, there are two problem areas. Firstly, the authors appear unaware that Juan Cierva registered and used the name "Autogiro" for his machine, and for his company, but the authors incorrectly use "autogyro" in this context.

Cierva may also be used to highlight the second issue — incorrect technical attribution — concerning the "spider" control system. The pioneering Spanish designer recognised the need for flapping (and later) lag hinges/dampers, but he never implemented cyclic pitch, or collective pitch, other than for one-off jump starts. As a result, the claim in Chapter 3 that Cierva invented the Wasp's "spider" control system is entirely incorrect. The spider control system was invented by Austrian Raoul Hafner to provide cyclic and collective pitch control on the 1935 Hafner AR III autogyro G-ADMV. This arrangement has no linkage to Cierva, who used a tilting rotor head for pitch and roll control of his Autogiros.

Despite these concerns, this is generally an excellent work which highlights the real and operationally significant contributions of the Westland Wasp, and its tight-knit teams of pilots and maintainers.

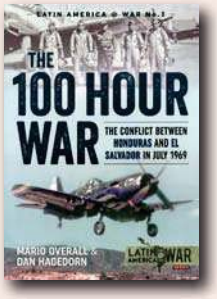
Overall, the book is well worth buying if you can overlook the misspelt company names and the not-quite-adequate glossary and proof-reading. Enjoy instead the first-hand voices and anecdotal experiences that speak volumes about the capable and much-loved Wasp helicopter.

Dr RON SMITH FRAeS

BOOKS IN BRIEF

A quick round-up of what else is currently available for the aviation history enthusiast

THE 100 HOUR WAR
Mario Overall & Dan Hagedorn
Helion & Co; ISBN 978-1-911096-50-4; £19.95

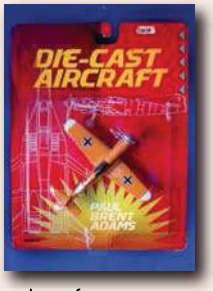


SUBTITLED *THE CONFLICT Between Honduras and El Salvador in July 1969*, the third in Helion's excellent *Latin America @ War* series details what is often rather derogatorily referred to as the "Soccer War"; but which, as *TAH* author Dan Hagedorn and Mario Overall explain, was the result of longstanding political tensions in Central America, not helped by American commercial interests in the region. The story of the last conflict involving exclusively prop-driven aerial combat is expertly told, accompanied by photos of varying quality (all still invaluable), five colour maps and 22 fine colour profiles by Tom Cooper. Recommended. **NS**

TEMPEST V vs FW 190D-9
Robert Forsyth
Osprey Publishing; ISBN 978-1-472829-25-23; £13.99

AS ANYONE WHO has read Pierre Clostermann's classic war memoir, *The Big Show*, will recall, some of the fiercest dogfights of the Second World War were fought between the twin apogees of German and British wartime fighter development, respectively the Focke-Wulf Fw 190D-9 "Dora" and Hawker Tempest V. Both were designed essentially to kill the other and both suffered from engine problems, making for a remarkably even match, despite the six-ton Tempest's considerably greater bulk. Luftwaffe specialist Robert Forsyth, a gifted writer able to maintain a high level of readability for the layman while also delivering a great deal of hard info, delivers a superior potted history of both types and their intertwined destinies. Curiously though, 33-victory ace Clostermann doesn't get a mention. **NS**

DIE-CAST AIRCRAFT
Paul Brent Adams
Amberley Publishing; ISBN 978-1-445683-74-4; £14.99



THIS 6½in x 9¼in softback from Amberley is a treat for anybody who loved die-cast aeroplanes as a kid — and for those who still do (the collectors' market remains in rude health). A veritable mine of "fancy that!" info about the history, construction and even packaging of (predominantly) metal scale aircraft, this well-illustrated 96-page volume, written by an author who clearly knows his stuff, is great fun, not least because you will *definitely* find yourself saying "I had one of those!" **NS**

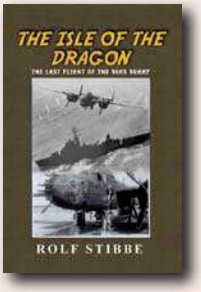
GLOSTER GLADIATOR
Adam Cotton & Marek Ryś
Kagero Publishing; ISBN 978-83-65437-86-0; £18.02

GOOD MONOGRAPHS on interwar/early World War Two types are always welcome, and this hefty 216-pager from Polish publisher Kagero is no exception. Covering all production variants, the Mks I and II plus the Sea Gladiator, it comprises a brisk and well-illustrated text by Adam Cotton plus — and this sets it apart — 120 pages of digital colour perspective, detail and profile views by artist Marek Ryś. Replacing the more usual collection of "anatomy" photographs, these include impressive cockpit, engine and uncovered-airframe views, which provide a crisp consistency of detail likely to be of value to modellers and those with an engineering background. **MO**

POLISH WINGS No 24: MiG-19P & PM/ MiG-21F-13
Lechosław Musiałkowski
MMP/Stratus; ISBN 978-8-365958-06-8; £15

IN 1958 THE Polish Air Force took delivery of its first supersonic aircraft, the Soviet-designed MiG-19, also Poland's first twin-engined fighter. Three years later, it began to equip with the single-engined Mach 2+ MiG-21, and it is these two types covered in the 24th of MMP/Stratus's comprehensive *Polish Wings* series. The slightly fractured English aside, this is an invaluable guide to the pair in Polish service, dealing with several persistent myths once and for all and offering an impressive selection of photographs and colour profiles. Note to publisher — lose the recessed sky background on every page; it adds nothing. **NS**

THE ISLE OF THE DRAGON
Rolf Stibbe
Dorrance Publishing; ISBN 978-1-4809-9503-1; US$16



SUBTITLED *THE Last Flight of the Bugs Bunny,* this softback is a novel, not a history (so it's unusual for *TAH* to review it) but it is inspired by, and based on, sound historical foundations. The author interviewed former World War Two Mitchell pilot Maj Erwin Werhand USAAF, who flew in combat in New Guinea during 1944–45 in the real B-25 *Bugs Bunny,* and this sparked the idea for a "jungle adventure story" about a lost bomber crew. Lively and immediate, and told in the present tense, the yarn is rounded off with a final chapter telling Werhand's real story. **MO**

Lost & Found

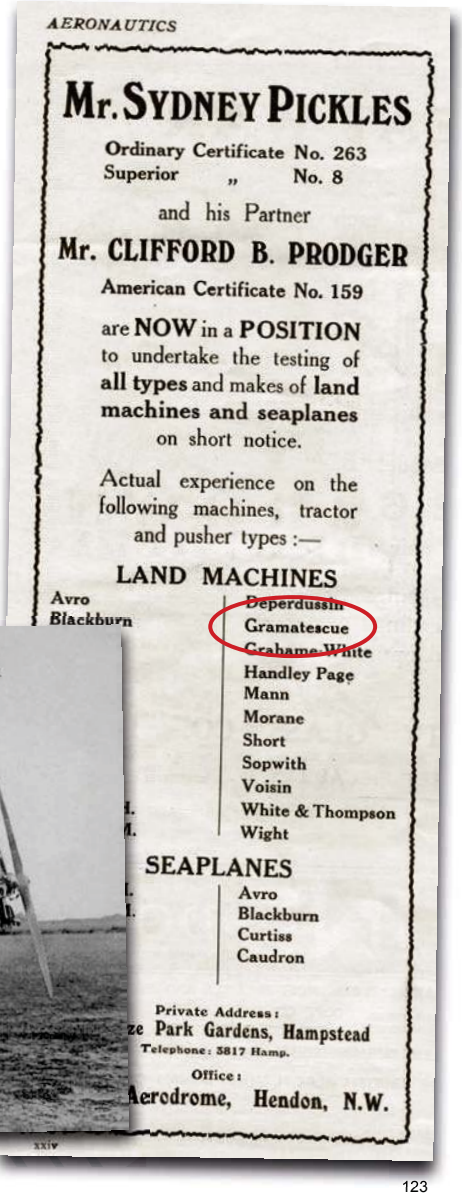
***PHILIP JARRETT** explores the lesser-known corners of aviation history, discovering little-known images and rediscovering long-lost details of aircraft, people and events. This time he solves one mystery but is on the hunt for information about another arising from it*

SOMETIMES, WHEN YOU'RE searching for one thing, you find an answer — or a partial answer — to something else that has perplexed you. A few years ago I found the advert depicted here in the January 5, 1916, issue of *Aeronautics* magazine. Two famous pilots of the era, Sydney Pickles and Clifford Prodger, had set themselves up as freelance test pilots, and in this advertisement for their services they listed the variety of types they had flown. All were familiar to me but for one, the "Gramatescue".

Then, a short time ago, while perusing Leo Opdycke's book *French Aeroplanes Before the Great War* (Schiffer, 1999), I stumbled unexpectedly upon a monoplane designed by George Gramaticescu, a Rumanian, who died of pulmonary tuberculosis before it could be built. His mother Emilia had it built in France by a team led by pilot Maurice Herbster, and it flew at La Vidamée on April 30, 1914, powered by a 50 h.p. Anzani radial engine. The fate of a planned second machine is unknown. The most distinctive feature of Gramaticescu's monoplane is its 8·5m (27ft 10⅔in)-span wing, in which the front half of the aerofoil is twice as deep as the rear section, producing a distinct step in the underside at approximately half-chord. In the original design, there was a second full-span wing of shorter chord immediately behind and below the main wing, creating a slot between them.

It would be nice to know which of the two pilots, Pickles or Prodger, flew the Gramaticescu, and the circumstances of his involvement with the project. At least my curiosity regarding the advertisement has been addressed.

BELOW ***The advertisement in the January 5, 1916, issue of* Aeronautics*, which includes a "Gramatescue" as one of the types flown by either Sydney Pickles or Clifford Prodger.*** **BOTTOM LEFT** ***A 1914 French postcard of the "Gramatiscesco" monoplane. Note the curious aerofoil section.***


AERONAUTICS

Mr. SYDNEY PICKLES

Ordinary Certificate No. 263
Superior „ No. 8

and his Partner

Mr. CLIFFORD B. PRODGER

American Certificate No. 159

are NOW in a POSITION to undertake the testing of all types and makes of land machines and seaplanes on short notice.

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Telephone : 3817 Hamp.

Office :
Aerodrome, Hendon, N.W.

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Say Cheese!

Flying with Hunting Surveys Ltd, 1959–61

In the first half of a two-part series covering his adventurous two-year stint as a pilot for Hunting Surveys Ltd, ED WILD recalls joining the company in 1959, his first encounter with the legendary DC-3 and learning his trade from a wise old hand during a posting to Iran to perform oil survey work

THE MORNING I was rostered to make my first operational flight I was apprehensive. Apart from it being one of the first all-metal aircraft I would fly, never having been aboard a Douglas DC-3 I was uncertain that I would know how to open its door, let alone fly the thing. Nevertheless, I felt considerable elation at the prospect.

The world of general aviation in Britain was recovering well from the aftermath of war, and in 1957, aged 25, I joined Elstree Flying Club in Hertfordshire as its junior full-time flying instructor. I held a Commercial Pilot's Licence and an Assistant Instructor rating. My flying experience comprised a meagre 230hr. Working as a flying instructor was rewarding, and I absorbed a great deal; "you'll learn as much as your students" they said — and it was true. Although very satisfying, instructing offered limited prospects, however.

After some two years at Elstree I was restless. So when Hunting Surveys Ltd, which occupied a hangar on the airfield, advertised for a pilot for photographic work, I applied. At the interview I learned that there might be a chance to progress to other types later, but "no promises".

The sharp end

My new employment commenced in the spring of 1959, and, after completing a check-ride in Auster Autocar G-AOFM, I was soon flying

RICHARD T. RIDING

every day. Progress then became bewilderingly rapid. Within weeks I had been checked out on de Havilland Dragon Rapide G-AIYR, followed by Avro Anson G-AMBE. Both types were flown with a single pilot, the Rapide by necessity; there was only one seat at the sharp end. At that time I had no instrument rating, not that such a qualification was necessary; this was aerial work, of the kind that normally required flying in gin-clear conditions under blue skies.

The Hunting Group was a large conglomerate and diverse in its scope, having long had interests in shipping and oil. From 1936 aviation became a growing part of its activities. Among the well-established names on its books were Rollason Aircraft & Engines (later Field Aircraft Services), Percival Aircraft and a short-lived joint venture — the Aircraft Manufacturing Company (Airco) — between de Havilland and Fairey Aviation. Aerial survey became part of the growing Hunting empire in 1944.

After a few weeks on the Rapide and Anson, I received an urgent request from the Air Registration Board (ARB) to sit the written examination for the DC-3. "On a separate sheet of paper, candidates are required to draw a diagram of the fuel system, labelling any valves or controls", part of it read. There was no conversion course, no "multiple-choice" exam, just a set of slightly smudged typewritten notes purchased from Sir John Cass College, printed by duplicator using a stencil that had already produced more than one too many copies. I still have mine. Nor did I have any published documentation. With little idea of what to expect once I had climbed aboard, this was truly on-the-job training. I was nervous — but ecstatic.

Heavy iron

Tuesday, May 26, 1959, found me about to join Hunting's DC-3 G-AMSV, whose captain and crew, none of whom I had met previously, were awaiting me at Gatwick. We were about to depart on a ten-week expedition to Iran, then still governed by a royal dynasty, with the Cultural Revolution still 20 years away.

I had completed the ARB's DC-3 written type-rating exam, but this was to be my first flight in the real thing; it seemed huge. I recall an assault of smells from this first encounter — a mix of 100-octane fuel, hydraulic fluid, leather — and several others besides. The interior bore obvious signs of a hard life, with paint almost completely gone from the floor and metal parts bearing various scratches, scuff marks and dents. The bucket-shaped green leather seats were worn smooth and shiny.

I joined our ground engineer on his pre-flight walkaround. Neil, who was to accompany us on the trip, was a short, spritely Australian of few words, but nonetheless generous with his advice. Our aircraft seemed solid, built on a Victorian

OPPOSITE PAGE ***The author at the controls of Dragon Rapide G-AIYR, photographed while up from Elstree by RICHARD T. RIDING. Note the Hunting Surveys Ltd logo on the nose.*** **ABOVE** ***Another of the Elstree-based aircraft the author flew was Auster J/5P Autocar G-AOFM.*** **TOP** ***The author's Elstree Flying Club membership card, 1961.***


پروانه عبور در مناطق مرزی وممنوعه
نخست وزیری
شماره ۲۷۲۳
تاریخ ۱۳۳۸/۲/۱۱
س. ا. و. ا. ک
BURTON ROWLAND
آقا
تاریخ تولد ۱۹۱۸ تابعیت انگلیسی
پدر
شغل
گذرنامه
خط سیر
مدت از
۳۷ - ۲۳۶/ه

LEFT ***For the Iranian survey trip in 1959 the Hunting team required work permits, and this is "Monty" Burton's, although his forename, Roland, has been given an erroneous "w". The Canberra PR.3, WE139, in which Burton won the Speed Section of the 1953 London—Christchurch air race, is on display at Royal Air Force Museum Hendon.*** AUTHOR'S COLLECTION

BELOW ***Hunting operated a total of nine DC-3s throughout the 1950s, including G-AMHJ, acquired by the company in April 1957. Presumably the organisation's DC-3s were in use on other tasks in May 1959, hence the charter of G-AMSV, not a Hunting-owned machine, for the author's Iranian survey trip.***

scale with huge rivets and wheels, 100-octane fumes blurring visibly beneath the wings, discharging through vent pipes from the tanks above. Brunel would have been at home here.

Neil asked how much DC-3 time I had. "None" I replied. "Well, what do you think of it?" he asked, nodding at the aircraft. "It's big" I said. "Yeah, could make a lotta saucepans out of this beaut", was his response.

Monty in charge

The captain and expedition leader was the late Sqn Ldr Roland L.E. Burton AFC and Bar, known to friends as Monty (after Montague Burton, founder of the British men's clothing company). Although he never mentioned it, I learned much later that he had piloted the winning aircraft, English Electric Canberra PR.3 WE139, in the 1953 London—Christchurch Air Race, leading the field in record-setting time. For this working-class, minimally educated young man from a Birmingham council estate, Monty was to prove a godsend.

We departed Gatwick early the following morning for a test climb to 26,000ft (7,900m). It was unusual for the DC-3 to operate at such rarefied levels as it was unpressurised. To improve climb capability, Hunting's DC-3s were fitted with two-stage blowers (superchargers), allowing the aircraft to achieve the altitude necessary for aerial photography. Breathing oxygen was essential (another first for me), supplied from very large bottles. Approaching 10,000ft (3,000m), Monty ordered everyone to put on their oxygen masks and check in via intercom when they had done so. Regular oxygen checks continued throughout the flight.

The supercharger controls were accessible only from the right-hand seat and I had the task of activating the second-stage blowers as we passed through 15,000ft (4,500m). I had only read about this feature previously and was expecting the additional power to provide a real kick in the pants. I was to be disappointed; the only change was a modest flicker on the boost gauges.

The climb occupied nearly an hour; getting down took nearly as long, Monty keeping the rate of descent at 500ft/min (150m/min) in deference to a couple of crew members with head colds. All of this was new territory for me.

Two days later, after a few last-minute delays, we departed Gatwick for Tehran and the start of a fascinating tour. After the final loading of equipment and stores was complete, the aircraft's interior resembled an overloaded furniture van. There were seven souls on board:

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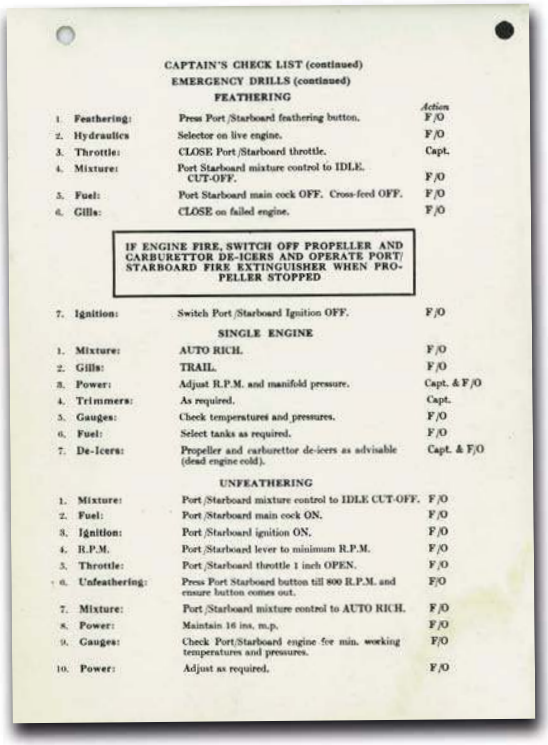


CAPTAIN'S CHECK LIST (continued)
EMERGENCY DRILLS (continued)
FEATHERING

			Action
1.	Feathering:	Press Port /Starboard feathering button.	F/O
2.	Hydraulics	Selector on live engine.	F/O
3.	Throttle:	CLOSE Port /Starboard throttle.	Capt.
4.	Mixture:	Port Starboard mixture control to IDLE CUT-OFF.	F/O
5.	Fuel:	Port Starboard main cock OFF. Cross-feed OFF.	F/O
6.	Gills:	CLOSE on failed engine.	F/O

IF ENGINE FIRE, SWITCH OFF PROPELLER AND CARBURETTOR DE-ICERS AND OPERATE PORT/STARBOARD FIRE EXTINGUISHER WHEN PROPELLER STOPPED

7.	Ignition:	Switch Port /Starboard Ignition OFF.	F/O

SINGLE ENGINE

1.	Mixture:	AUTO RICH.	F/O
2.	Gills:	TRAIL.	F/O
3.	Power:	Adjust R.P.M. and manifold pressure.	Capt. & F/O
4.	Trimmers:	As required.	Capt.
5.	Gauges:	Check temperatures and pressures.	F/O
6.	Fuel:	Select tanks as required.	F/O
7.	De-Icers:	Propeller and carburettor de-icers as advisable (dead engine cold).	Capt. & F/O

UNFEATHERING

1.	Mixture:	Port /Starboard mixture control to IDLE CUT-OFF.	F/O
2.	Fuel:	Port /Starboard main cock ON.	F/O
3.	Ignition:	Port /Starboard ignition ON.	F/O
4.	R.P.M.	Port /Starboard lever to minimum R.P.M.	F/O
5.	Throttle:	Port /Starboard throttle 1 inch OPEN.	F/O
6.	Unfeathering:	Press Port Starboard button till 800 R.P.M. and ensure button comes out.	F/O
7.	Mixture:	Port /Starboard mixture control to AUTO RICH.	F/O
8.	Power:	Maintain 16 ins. m.p.	F/O
9.	Gauges:	Check Port/Starboard engine for min. working temperatures and pressures.	F/O
10.	Power:	Adjust as required.	F/O

two pilots, a navigator, radio operator, engineer and two photographic darkroom technicians.

Our route was Gatwick—Alghero (Sardinia)—Brindisi (Italy)—Athens (Greece)—Ankara (Turkey)—Tehran. The estimated flight time was 21hr, and I performed what I thought were appropriate first officer duties on the early legs. I was therefore surprised when, during the stop at Athens, Monty informed me I would be making the next take-off and subsequent landing at Ankara. "It's your leg", he said. Things went moderately well until we came to the landing. It was to be the worst of my entire career and I still flinch just thinking about it.

Coffin corner

On approach to Ankara Monty provided helpful prompts, and I felt fairly relaxed, although the remainder of the crew seemed to be taking an unusually keen interest, filling the passageway behind the cockpit. The first touchdown seemed to kiss the runway, and I came back on the yoke. Whoops! We were airborne again, so I eased the nose down rapidly, only to contact the runway even more firmly, initiating another bounce. As we galloped across Ankara airfield, the gyrations became higher and slower each time. Short of a go-around I couldn't see how I was going to rescue the situation until, at the next touchdown Monty said "now push gently forward". I did so and the wonderful old lady stayed glued to the runway, obviously bored of playing games with this incompetent novice.

Our task in Iran was to conduct a photographic

"I eased the nose down rapidly, only to contact the runway even more firmly, initiating another bounce. As we galloped across Ankara airfield, the gyrations became higher and slower each time. Short of a go-around I couldn't see how I was going to rescue the situation . . ."

LEFT ***An extract of the author's copy of the emergency check list for the DC-3 — all rather more complicated than for the smaller types he was used to flying with the Elstree Flying Club. Before joining the latter, he was a part-time instructor on Tiger Moths and Austers at the Wolverhampton and Midland Aero Clubs.***

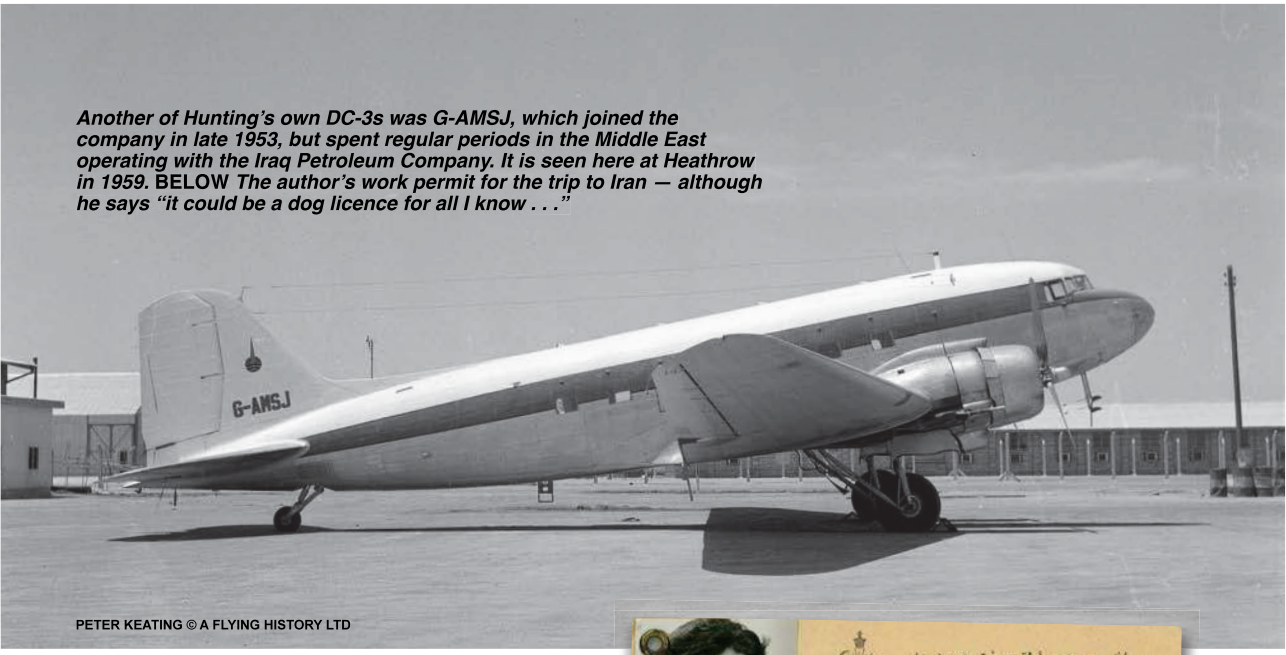
survey for oil, to be performed at high altitude. The daytime temperatures were high, so it was necessary that cool, early morning starts were made, to assist the climb performance before the air temperature rose. The chosen departure time was 0400hr, after which there would be sufficient light for photography, having reached our operating altitude of 27,000ft (8,200m). Although promising initially, our rate of climb soon became only modest. Not only that, the cylinder-head temperatures were climbing faster than we were. "Keep an eye on them", cautioned Monty.

At 7,000ft (2,100m) the needles were creeping ever closer to the red line — our poor Pratt & Whitneys were cooking. We flew level for a while to increase cooling flow through the big radials and continued a step-climb procedure until the temperatures had fallen sufficiently to allow a slow but continuous climb. We settled at 27,000ft in just under 2hr, our indicated airspeed a little over 80kt, close to the best single-engine speed. I tried my best to sound unconcerned when mentioning this. "Welcome to coffin corner", said Monty.

After a few days, our operation moved to Shiraz in south-central Iran and Masjid-i-Suleiman (Masjed Soleyman) in the south-west. Sorties from Tehran were long, averaging more than 7hr, so the decision was made to move our base closer to the photo-run tracks. Almost everybody had dual roles. For instance, both pilots took turns operating the camera when at photo height. Hunched over the equipment, awaiting the navigator's "camera on, camera off" calls, it was an undemanding task. At regular intervals a Weston light meter was placed on the plate-glass photo-window to check that the correct exposure was being maintained. Approximately 60 per cent overlap was required for each photograph, and this was timed automatically, the overlap enabling viewing of a pair of prints in 3D.

Unless cloud cover obscured the target, we

Another of Hunting's own DC-3s was G-AMSJ, which joined the company in late 1953, but spent regular periods in the Middle East operating with the Iraq Petroleum Company. It is seen here at Heathrow in 1959. **BELOW** *The author's work permit for the trip to Iran — although he says "it could be a dog licence for all I know . . ."*



remained at photo height until light levels had fallen to a value that precluded further photography. That signalled time to go home, and the long, slow, ear-popping descent began.

The red light

There was little time for relaxation. Neil was always first at the airfield ready for our pre-dawn take-offs, although we became aware that he had checked out of our hotel. After completing a sortie one evening, he said "I want to invite you all to my new club", handing out business cards with an address in town. "Come and have a drink, meet my friends, it's on me." Later that evening we sought this mystery place, tucked away in the back streets, and found ourselves in a dimly lit bar.

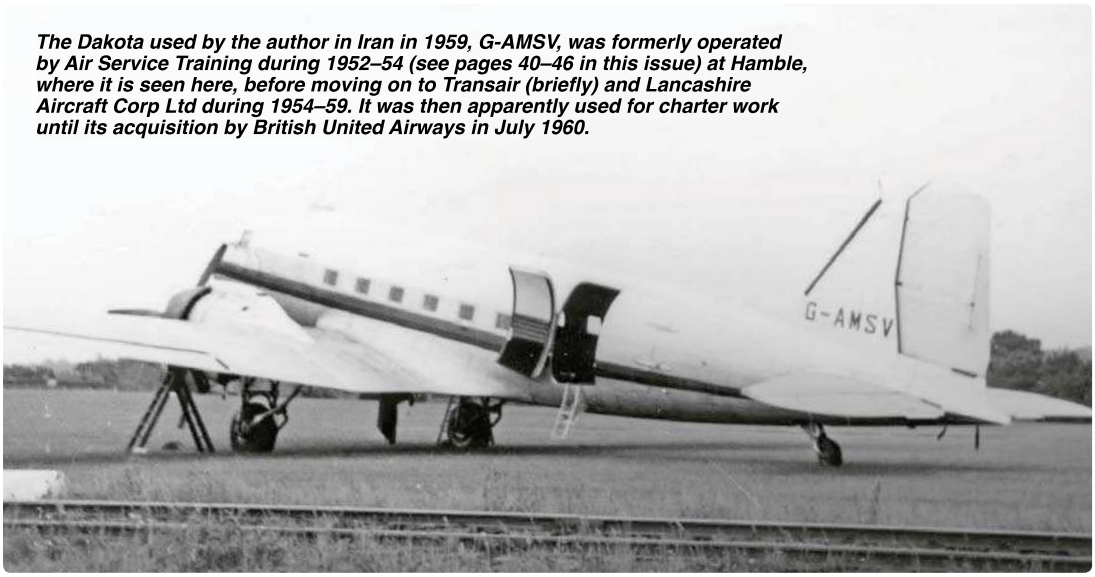
Neil was holding court and promptly dispensed drinks all round. This was during the reign of the Shah, before the Islamic Revolution, when such behaviour was tolerated. There was more to follow. "Now, come and meet my friends", invited Neil, leading us into an inner room, where we found scantily-clad young ladies sitting around chatting. The penny dropped — we were in a brothel! Later we learned that Neil had drawn his allowances for the entire trip a few days previously. The reason for doing so was now only too apparent.

One of our crew with a particularly difficult job was Ron, our navigator. Not only did he have to find the target lines, he also had to ensure we stayed on them. Accurate positioning is crucial in air survey work. Charts and photographs from various sources helped, but map reading was not always easy, particularly over desert areas. A favourite airborne pastime was to watch in silence as Ron took out the false teeth that caused him discomfort and place them on the navigation table. With Ron seemingly absorbed in his tasks, we watched, fascinated, as the normal vibrations running throughout the aircraft caused his dentures to gnash slowly towards the edge of the table. At this point Ron, who had appeared oblivious to this developing danger, shot out a hand and caught them.

We had regular operations out of Masjid-i-Suleiman, and it was here that we encountered a problem; high winds were blowing up fine sand in clouds. With the weather otherwise acceptable for photography, we taxied out. Shortly before take-off on one occasion, Ron called "Stop!" on the crew intercom. The delay was caused by fine powdery sand adhering to the plate-glass photo-window, thus obscuring the camera lens. There was no way to clean the window once airborne, so Ron climbed out of the aircraft to clean the glass with a chamois leather. Air Traffic Control had some difficulty understanding the nature of our problem.

Strong winds persisted the following day, but this time we were prepared with a more practical solution. Neil followed the aircraft out to the runway in the airport fire truck and when we were ready for departure, dashed under the belly and went to work with the chamois.

The operation moved to Shiraz, an ancient and



BRIAN STAINER/APN VIA PETER J. MARSON

The Dakota used by the author in Iran in 1959, G-AMSV, was formerly operated by Air Service Training during 1952–54 (see pages 40–46 in this issue) at Hamble, where it is seen here, before moving on to Transair (briefly) and Lancashire Aircraft Corp Ltd during 1954–59. It was then apparently used for charter work until its acquisition by British United Airways in July 1960.

attractive city about 335 miles (540km) further south. Monty was quick to remind everyone that the ruins of Persepolis, the capital of the Achaemenid empire (550–330 BC), were close by and duly organised a day out. His detailed descriptions of what we were seeing rendered superfluous the need for local guides. By the end of our walkabout, much to the irritation of the local guides, a small group of tourists had attached themselves to our party, with Monty fielding their questions with aplomb.

Back to Blighty

Operations settled into a comfortable routine, resulting in lines of stapled-together contact prints covering the darkroom floor. The weather remained fine, and our photographic sorties neared completion.

On July 5, 1959, we departed Tehran, routing via Ankara and Istanbul before night-stopping at Naples. Once there, Monty, ever the history buff, insisted we visit Pompeii, treating those who had the inclination to a fascinating day out. Two days later, on July 7, we taxied on to our stand at Gatwick. Although I did not fully appreciate it at the outset, Monty had been the ideal person to introduce me to the DC-3; to the flying skills needed for its safe operation, and to the craft of aerial survey. He was kindness itself, coaching this rookie, who had much to learn in the art of aviation, through the difficult early stages.

Fortunate to have him as a mentor, I had gained much valuable experience with the DC-3 and felt reasonably comfortable operating the aircraft. Reassuringly, the other crew members had even stopped crowding into the narrow cockpit area whenever I made a landing!

NEXT TIME *Ed heads overseas for more oil-survey flying adventures, this time in East and West Africa . . .*

BELOW ***Morton Air Services was part of British United and G-AMSV joined the Morton fleet in 1962, operating in a variety of roles, from pure cargo to ferrying Ford Motor Company executives to and from the Continent until 1968, when Morton was absorbed into British United Island Airways; 'MSV was acquired by Air Atlantique in March 1982.***

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OFF THE BEATEN TRACK

Ever turned a corner to find something unexpected? The Aviation Historian's *intrepid aeronautical explorer* ***PETER DAVISON*** *investigates the stories behind the oddities that turn up in the most unusual places . . .*

AT LEAST SEVEN, possibly as many as nine, Fairchild C-119F Flying Boxcars are preserved in fair condition across Taiwan (aka Republic of China), mainly in museums or technical institutions. This example, Republic of China Air Force (ROCAF) serial 3160 (c/n 10724, formerly 51-7985 in USAF service), resides at Xihujunji Park in Xihu, Changhua, about 125 miles (200km) south-west of Taipei, accompanied by a Northrop F-5, North American F-100 and a Lockheed RF-104 Starfighter, alongside various tanks and missiles.

PHOTOGRAPHS BY THE AUTHOR

The Flying Boxcar was developed from the same company's C-82 Packet as the XC-82B and first flew on November 17, 1947; more than 1,180 were produced by Fairchild during 1947–55. Taiwan received 114 examples from 1958, equipping three ROCAF squadrons until the type's retirement in 1997.

Of those visited in late 2018, some housed display panels explaining its role, particularly in parachuting troops and cargo, and some have accessible cockpits, while others are completely closed up with established trees blocking internal inspection or photographic opportunities.

One online review defends the need for peaceful relaxation in a city park, suggesting military items are best preserved in museums, although most locals seem keen for children to appreciate aeroplanes at close quarters. With parts of Asia full of "military parks", the reviewer may have a point, however. This park is presently being refurbished to re-open in November 2019.

1939: was the RAF ready? / france's nuclear SST / louis zamperini / indonesia's hamble boys / P.1127 — the politics / TWA's martinliners / the first air logbook / Britain and laminar flow / the 1975 mayaguez incident / by mosquito to argentina

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